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Citrus Insect Control For December, 1959

Hydrocooling Studies With Florida Citrus

Influence of Various Rootstocks of The Cold Resistance of Scion Variety of Citrus

J. B. Graves Makes Statement Outlining FCC Purposes and Problems

Unfruitfulness In The Orlando Tangelo

Concentrate Pack Will Be Less Than Last Year

DR. S. JOHN LYNCH
Director Experimental Farm Division of Research and Industry, University of Miami,
Newly Elected President
Florida State Horticultural Society

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VOL. 39 — NO. 12 DECEMBER, 1958 BARTOW, FLORIDA

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5-58

W. L. Thompson

Citrus Insect Control For December 1958

W. A. Simanton

W. L. THOMPSON
W. A. SIMANTON
R. B. JOHNSON*
Florida Citrus Experiment Station, Lake Alfred

R. B. Johnson

Scale infestations were well above average in November. Red scale populations increased sharply during the month to a high level. Although a general decline will occur during December, red scale infestations are expected to remain above average through the winter. Purple scale maintained moderately high infestations throughout the state during November. A slight decrease in population is indicated for December. More purple scale than usual have been noted this fall on or near the fruit stem. This has been a factor in fruit droppage.

Purple mite is somewhat below normal over the state at this time. While the general infestation is not expected to depart from average levels during December, damaging populations will show up in many groves. Texas citrus mite infestations have built up steadily for the past two months. Although present in a relatively small number of groves, this mite can occur in large numbers and may be a problem during December in some areas.

Rust mites increased sharply from a low level in October. November populations were high and are expected to go higher in December.

SPRAY PROGRAM

Scale Control: Groves that have not had a fall scalicide should be checked for purple scale, chaff scale, and Florida red scale, because infestations of any of these may be very injurious and costly. Even a light infestation of purple scale around the stem-end of fruit can cause a severe fruit drop. Both purple and chaff scale cause grade-lowering green spots that cannot be removed from fruit in the coloring room, and both purple and red scales can cause severe defoliation with subsequent fruit drop and dead wood.

Although oil sprays are just as effective against scale insects during the winter as at any other time, they are not recommended for winter use. Oil is a definite shock to citrus trees. It makes them more susceptible to cold injury and may cause a high percentage of late-bloom fruit the following year. Oil also interferes with degreening. Parathion and malathion do not have these adverse effects and are therefore recommended in preference to oil. Parathion 25 per cent (or its equivalent in other formulations) at 1.0 pound per 100 gallons or malathion 25 per cent at 4 to 5 pounds should be used for moderate to heavy infestations of scale. Lower dosages of .6 pound of parathion 25 per cent or 3.0 pounds of malathion 25 per cent will be satisfactory for light infestations.

Regardless of the scalicide used, thorough coverage is essential for best results. This seems to be particularly true during the winter. Poorer control of scale insects is usually obtained during winter months than in the summer. This may be due partly to differences in weather, but is also due largely to the difficulty of obtaining thorough coverage with the heavy weight of fruit on the trees. More attention should be paid to coverage during the winter than at any other time of the year.

Parathion and malathion are compatible with most of the materials recommended for mite control. There are a few exceptions. Although both may be used with DN Dry Mix No. 1, severe leaf drop has occurred with such mixtures. Furthermore, where there is a breakdown of the peel of oranges, the mixture of DN and parathion increases the injury. Hamlins and Pineapples are most susceptable to this type of injury. Although parathion may be used with lime-sulfur, the possibility of using malathion with lime-sulfur has not been investigated.

Purple Mite and Texas Citrus Mite Control: During the spring and summer months citrus trees are usually able to withstand large numbers of purple mite and Texas citrus mite as long as soil moisture is adequate. This is definitely not true during the winter. Winter is normally dry with periods of windy weather, conditions that are favorable for mesophyll collapse and firing. These types of injury are always more severe where purple mite or Texas citrus mite are present, even in small numbers. For this reason, groves should be checked regularly throughout the winter months so that miticides may be applied before 20 per cent of the leaves are infested. This is the best way to prevent severe leaf drop and dead twigs. It is also the best way to obtain a long period of mite control.

During cool weather purple mite has a tendency to congregate on the green twigs and the lower surface

SCALE AND MITE ACTIVITY BY DISTRICTS *

District	Purple Scale	Red Scale	Purple Mite	Rust Mite on leaves	Rust Mite on fruit
West Coast	3.09	3.21	1.92	2.92	3.33
Indian River	2.65	2.70	.94	1.43	1.16
Upper East Coast	5.26	3.71	1.43	1.72	1.17
Gainesville	3.50	.33	.67	1.67	1.17
Orlando	3.04	2.34	.62	.50	.76
Brooksville	2.98	.29	1.07	1.79	1.85
Ridge	4.11	4.13	1.90	2.00	2.09
Bartow	4.53	4.40	1.10	2.69	2.60
State Average	3.55	3.25	1.27	1.74	1.81
Last Year	3.92	2.95	1.19	2.46	2.27

* Third week in November. Activity is computed from populations, amount of hatching of scales, and number of groves with increasing or decreasing infestations. Activity is considered high if above 4.0 for purple scale, 3.0 for red scale, and 1.5 for mites.

* Written November 24, 1958. Reports of surveys by Harold Holtsberg, Fort Pierce; J. W. Davis, Tavares; K. G. Townsend, Tampa; T. B. Hallam, Avon Park; and L. M. Sutton, Lake Alfred.

at the base of the leaves. Eggs are usually laid in large numbers in these locations. These areas, as well as the tops of trees, should be inspected when checking for this mite. As much attention should be paid to mite eggs as to the mites themselves because even though mites are not numerous, the presence of mite eggs is a good indication of a forthcoming outbreak.

Materials recommended for control of both purple mite and Texas citrus mite include Tedion, Trithion, Kelthane, Systox, and DN Dry Mix No. 1.

No residue tolerance has as yet been established for Tedion on citrus fruit. This material should not be used on bearing citrus. It can, however, be safely applied on trees without fruit and a limited amount has been available for grower trial on bearing trees under an experimental sales permit.

Tedion is very slow to kill mites, but gives a long period of control. For best results, apply a thorough application of Tedion at ½ pound per 100 gallons before high populations of mites develop. If Tedion is used where mites are numerous, a quick clean-up can be obtained by the addition of such materials as parathion, malathion, TEPP, or Chlorobenzilate. Chlorobenzilate will also control rust mite. Tedion is believed to be compatible with all of the materials used on citrus.

Trithion at the dosage of 1 pound of wettable powder or ½ pint of liquid per 100 gallons not only kills active mites quickly but also gives a long period of control. Trithion is compatible with the materials recommended for use on citrus and may be used on all varieties up to 14 days before harvest. Trithion is also about as effective against rust mite as wettable sulfur and may be used for combined rust mite and spider mite control during the winter months.

Kelthane gives a quick kill of both purple mite and Texas citrus mite, but has not given as long a period of control of purple mite as either Tedion or Trithion. Kelthane is effective at dosages of 1 to 1-1/2 pints per 100 gallons. It should not be used in alkaline solutions, but it believed to be compatible with other materials recommended for use on citrus. Kelthane may be used on all varieties up to 7 days before harvest.

Systox at the dosage of ½ to 1 pint per 100 gallons gives a quick kill of mites and as long a period of control as Kelthane. Systox should not be used in alkaline sprays, but is compatible with other materials recommended for use on citrus. Systox may be used on oranges, lemons, and limes up to 21 days before harvest.

DN Dry Mix No. 1 at 2/3 pound per 100 gallons gives a long period of control only when thoroughly applied to low infestations where mite eggs are not abundant For very light infestations a 1-1/2 per cent DN-sulfur dust is fairly effective. No injury to fruit has been observed following a DN-sulfur dust, but mixtures of DN and parathion sometimes cause a leaf drop and may increase any breakdown of the peel of Hamlin and Pineapple oranges.

Rust Mite Control: Rust mite should be controlled throughout the winter for two reasons. First, rust mite can russet fruit whenever mites become numerous; and second, it can be as much of a factor in causing leaf drop as purple mite and Texas citrus mite.

Zineb at ½ pound per 100 gallons is the most effective material for rust mite control. It has no fumigative properties, however, and must be thoroughly applied for best results. Zineb can be mixed with all materials used for mite and scale control. However, DN is not as effective when used with zineb as with Chlorobenzilate or sulfur.

Chlorobenzilate at ½ pound per 100 gallons is not as effective as zineb, but when thoroughly applied, is slightly superior to sulfur.

Wettable sulfur at 10 pounds per 100 gallons, or 1 gallon of lime-sulfur with 5 pounds of wettable sulfur are satisfactory. Lime-sulfur is somewhat caustic, and should not be used on tangerines or early oranges.

Trithion at 1 pound or ½ pint is about as effective against rust mites as wettable sulfur if thoroughly applied. Trithion should be satisfactory for combined rust mite, purple mite, and Texas citrus mite control.

Details of spray schedules and the various materials used will be found in the "Better Fruit Program" and this should be consulted to determine which materials may or may not be combined. For further information, consult the Citrus Experiment Station at Lake Alfred or Fort Pierce.

SELL CITRUS ON TREE

Many growers in Lake County have sold their crops of oranges on the trees for $2.50 per box, with the buyer assuming the cold hazard, according to R. E. Norris, county agricultural agent with headquarters at Tavares.

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Hydrocooling Studies With Florida Citrus[1] . . .

. . . By . . .
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And
DR. F. W. HAYWARD
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DR. F. W. HAYWARD

DR. W. GRIERSON

A previous report to this society (2) emphasized the need for the development of efficient, economical refrigeration methods for citrus fruits that are packed in cartons and plastic bags. The increasing use of automated packing methods, combined with the danger from such endemic post-harvest diseases as stem-end rot and **Penicillium** mold, make the use of such packing methods hazardous unless efficient refrigeration, post-harvest fungicides or a combination of these two protective methods is used.

Hydrocooling has been found to be very successful for such crops as peaches, cherries, and many vegetables (2). Exploratory experiments at the Citrus Experiment Station (2) and at the University of Florida (10) have shown that the hydrocooling of Florida oranges is thermodynamically possible. However, little was known of the effect upon the physiology or pathology of the fruit except for one report of increased respiration rate following hydrocooling of California oranges (1). The Citrus Experiment Station packinghouse was therefore modified to permit hydrocooling on a pilot plant scale and much more extensive studies were carried out than had been possible in the past. During this season (that of 1957-58), two commercial packinghouses installed mechanically refrigerated hydrocoolers and automatic packing and bagging apparatus.

METHODS

Packinghouse Treatments.- As nearly as possible, packinghouse processes approximated those in commercial practice. The amount of degreening used depended on the initial color of the fruit and varied from 60 hours at the beginning of the season down to zero just prior to the mid-December freeze. Hydrocooling was done in the experimental hydrocooler previously described (2) and which is now equipped with a five-ton mechanical refrigeration unit. Throughout the experiments described here this unit was set to

[1] Florida Agricultural Experiment Station Journal Series No. 814.

deliver 1.66 pounds of 40° F. water per pound of fruit per minute. Waxing was either by means of an F.M.C. "Flavorseal" machine[a] or else in a dip tank which was used for lake Alfred 101A wax, an emulsion-type fungicidal wax (11).

Packing in cartons was done in a vibration pack unit manufactured by the F. B. Roberts Company and essentially similar to various makes of "volume-fill" units now being used in Florida. This machine packed on a basis of weight, not count, and (there being only one unit) the fruit was not sized. Packing in bags was done by hand. For this, the oranges were sized on standard belt and roll sizers that dropped them into packing bins. At the bins, they were packed into five-pound bags and the bags sealed in fibreboard master containers as rapidly as possible to avoid warming of the hydrocooled fruit.

A flood-type color-add tank was used to warm the fruit to simulate conditions in a commercial packinghouse using the color-add process. The tank was filled, however, with water, not color-add emulsion. In one series, this tank was used to give a half-hour treatment with room temperature water in order to help distinguish the cooling and the wetting effects of hydrocooling. For this, the color-add tank was filled with fruit and the circulating pump ran for half an hour with the conveyors stationary.

For experiments using sodium o-phenylphenate (Dowicide A) in the hydrocooler water (which we call "Dowicooling" for convenience), 0.1 percent of the commercial grade chemical was added to the hydrocooler, usually immediately after it had been used for hydrocooling. A trace of Dow-Corning "Antifoam A" was also added to eliminate foaming.

Those samples which were packed dry were dried in a hot air tunnel. With the experiments using early and mid-season oranges this had to be done on a small (18-inch width) line and considerable delay was involved. Valencia oranges were dried by passage through a slat drier on the main packinghouse line. Although fans and radiators were used for this, the fruit temperature rose surprisingly little during a two-minute pass through the drier. This is shown in Figure 1. Apparently most of the heat is taken up by the latent heat of vaporization of the surface water.

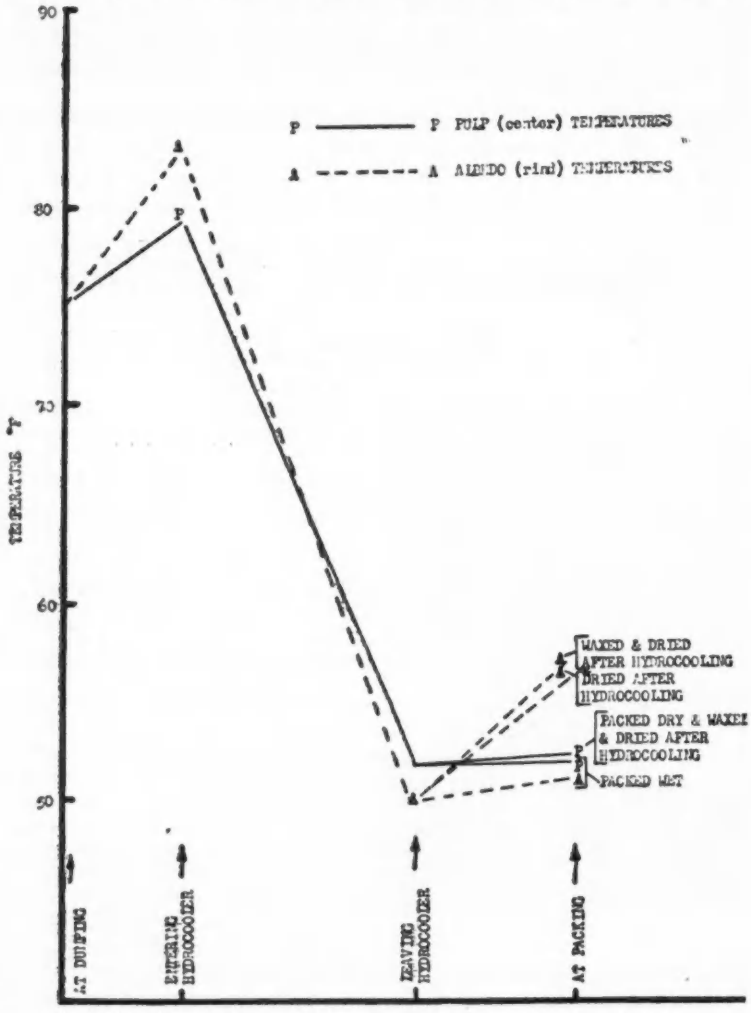


Figure 1. Temperature changes in Valencia oranges from dumping to packing during hydrocooling experiments.

Sample Size.- Samples were originally 20 4/5-bushel cartons per treatment with each experiment repeated five times, usually on suc-

On The Current Status Of "Dowicooling"

The report printed here deals with extensive experiments in which the fruit was put through comparatively rigorous tests to determine differences between treatments.

At the same time two commercial packinghouses were using the hydrocooling (usually with Dowicide A, or "Dowicooling") process and checks on arrivals were made by various commercial and government agencies. Between 150 and 200 carload equivalents were shipped in 1957-58 without adverse comment from commercial handlers. Thus the method has achieved commercial acceptance.

When the fruit is not particularly susceptible to decay, such results can be achieved with low temperatures alone. But, as the results in this paper indicate, when decay susceptible fruit is encountered, both low temperatures and the fungicidal effect of Dowicide A are necessary. Such factors must be controlled carefully lest this excellent record be spoiled by carelessness or abuse of this fairly exacting method.

Moreover, experimental work at the Citrus Experiment Station will be continued even if no commercial complaints occur, as part of a continuing project to find better or cheaper ways of achieving improved fresh fruit arrivals.

W. GRIERSON,
Citrus Experiment Station,
Lake Alfred.

[a] Loaned by the Food Machinery and Chemical Corporation.

cessive weeks. With the advent of the Valencia season, the number of treatments was increased and sample size was reduced to 10 cartons. Each carton held on the average 100 oranges. A typical experiment included up to eight treatments, each involving 10 samples of 100 oranges repeated five times, making a total of 5,000 oranges per treatment, or as many as 40,000 oranges in a single experiment.

Holding Conditions.- The simulation of shipping and market conditions provided some of the most difficult problems encountered. In commercial practice, large numbers of packed cartons are stacked together in freight cars or trucks, and temperature throughout the stack is usually affected more by the initial temperature of the fruits than by the ambient conditions around the cartons (5, 8). With 10 or 20 carton samples placed in constant temperature rooms, this is not so, and the fruit rapidly assumes the temperature of the room almost regardless of temperature at packing. In an attempt to delay these temperature changes, insulated cabinets each holding 20 cartons were used in the constant temperature rooms. In the experiments with Hamlin and Pineapple oranges, the fruit were put in these insulated cabinets in the 70° F. storage.

In the experiments with Valencia oranges and grapefruit, the various samples were moved from room to room (rooms at 40° F., 60° F., and 70° F., were available) in an attempt to reproduce the temperatures known to occur in freight cars and in market conditions (5, 8, 14). When considerable changes in temperature were involved, e.g., going from 40° F. to 60° F., the insulated cabinets were used to slow up rate of temperature change and to minimize condensation on the cartons and on the fruit. Fruit temperatures during such treatments are shown in Figure 2.

Fruit Examinations.- All samples were examined at 10 days and at

(Continued on page 11)

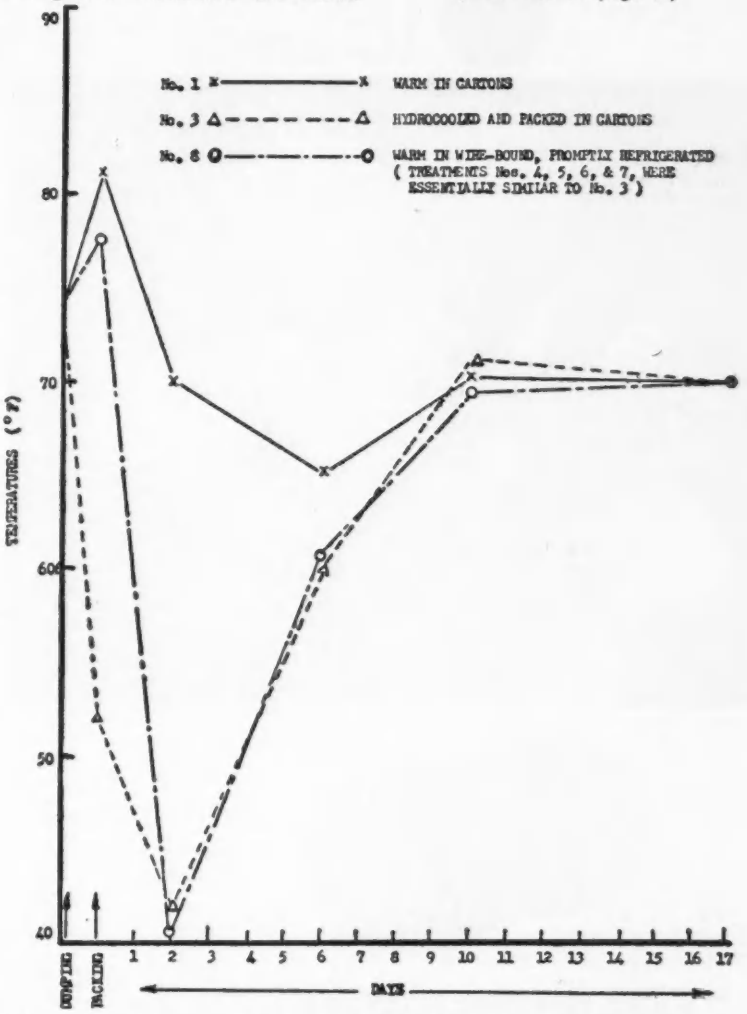
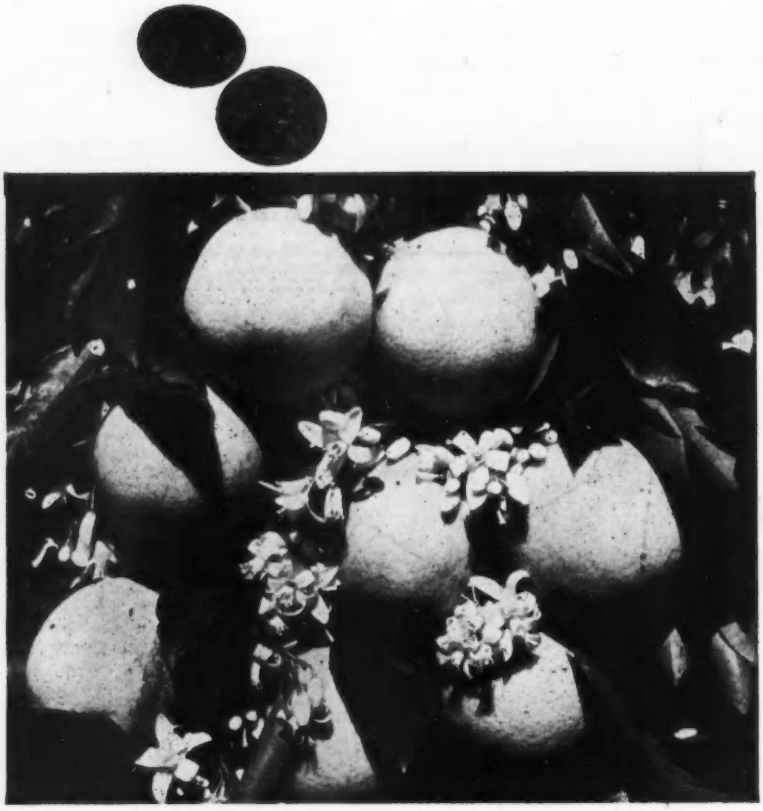

No. 1 WARM IN CARTONS
No. 3 HYDROCOOLED AND PACKED IN CARTONS
No. 8 WARM IN WIRE-BOUND, PROMPTLY REFRIGERATED
(TREATMENTS Nos. 4, 5, 6, & 7, WERE ESSENTIALLY SIMILAR TO No. 3)
TEMPERATURES (°F)
90
80
70
60
50
40
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
DUMPING
PACKING
DAYS

Figure 2. Valencia oranges in fibreboard cartons: Temperatures through the packing operation and during simulated transit and marketing conditions with and without hydrocooling, air cooling, and a non-refrigerated control.

Table 1. Effect of hydrocooling[1] and of Dowicooling[2] on losses from decay and peel injury and on gloss of Hamlin and Pineapple oranges packed in cartons after treatment.

Treatment	Variety	Number of experiments	Percent losses from decay		Percent losses from peel injuries		Gloss meter readings[3]		
			10 days	17 days	10 days	17 days	Initial	1 week	2 weeks
Control	Hamlin	5	51.0	68.9	3.6	5.2	42.5	36.7	30.2
Hydrocool (Wet)[4]	Hamlin	5	52.6n.s.	75.5n.s.	5.8*	7.5n.s.	39.6	31.9	28.8
Hydrocool (Dry)[5]	Hamlin	5	54.7n.s.	70.6n.s.	7.1n.s.	8.0n.s.	39.5	31.7	29.0
Picking dates (Oct. 16-Nov. 20, 1957)[6]			*	**	**	**			
Control	Hamlin	3	9.3	40.7	2.2	5.1	45.8	40.4	38.6
Dowicool (Wet)	Hamlin	3	3.5**	23.4**	3.3[7]	8.5	46.5	42.1	37.4
Dowicool (Dry)	Hamlin	3	4.2n.s.	23.4n.s.	5.5[7]	8.8	42.6	39.7	35.6
Picking dates (Nov. 27-Dec. 11, 1957)[6]			**	**					
Control	Pineapple	2	12.2	44.6	Not	7.6	46.5	41.6	39.4
Dowicool (Wet)	Pineapple	2	5.8**	26.0**	Recorded	31.2**	45.7	43.6	38.7
Dowicool (Dry)	Pineapple	2	8.3n.s.	28.8n.s.		26.2n.s.	44.1	40.7	37.8

1 Hydrocooling: Flooded with water about 40° F. for approximately 30 minutes.
2 Dowicooling: As for hydrocooling, but with 0.1 percent o-phenylphenate (Dowicide A) in the water.
3 Gloss read on a Photovolt glossmeter (12). The higher the reading the higher the shine.
4 "Wet" treatments were not dried after hydrocooling although surface water was shaken off on conveyors, etc.
5 "Dry" treatments were dried in a hot air drier after hydrocooling.
6 Statistical significance as (1) decrease in decay over picking period (2) comparison of control vs. hydrocool (wet) and (3) comparison of hydrocool (wet) vs. hydrocool (dry).
7 Statistical analysis not possible as peel injuries are from one experiment only (Nov. 27/57) as failure of controls on color-add tank caused additional injury to other two picks.



Concentrate Pack Will Be Less Than Last Year

The Florida citrus industry's frozen orange concentrate inventory at the end of the 1957-58 packing season Nov. 30, will be about 4,000,000 gallons less than for the same date the previous season, Robt. W. Rutledge, Florida Citrus Mutual general manager, forecast this week.

"Actually the concentrate inventory today is already under the amount of stocks on hand at the end of the 1956-57 packing season according to Florida Canning Association figures," Rutledge said. "The concentrate inventory carry-over at the end of last season was 10,949,886 gallons.

On Oct. 25 of this year, latest date for which official figures are available, total concentrate stocks amounted to 10,889,637 gallons."

Traditionally, the concentrate season runs from Dec. 1 to Nov. 30.

Rutledge said that at the present rate of movement there would be less than 7,000,000 gallons of cencentrate stocks on hand by Dec. 1.

"The average rate of concentrate movement for the first 47 weeks of the 1957-58 season was 1,217,000 gallons per week," Rutledge said. "Thus, for the last five weeks of the season only 778,000 gallons per week would have to be moved for the industry to have a total movement for the entire season of 61,100,452 gallons, leaving an end-of-season inventory of 7,000,000 gallons.

Rutledge said this compares with concentrate movement in the 1956-57 season totalling 74,009,868 gallons. However, he pointed out that there was a total pack that year of 72,011,741 gallons and a carry-over inventory from the previous season of 12,948,013 gallons, giving the industry a total supply for the 1956-57 season of 84,959,754 gallons.

HAMMETT TO SUCCEED C. D. GUNN AS FLORIDA SOIL CONSERVATIONIST

J. W. Hammett of Alexandria, La., will succeed C. D. Gunn as State Conservationist for the Soil Conservation Service in Florida Jan. 1, the U. S. Department of Agriculture has announced.

Mr. Hammett, who has been Deputy State Conservationist for Louisiana since May 1954, will have his headquarters at Gainesville.

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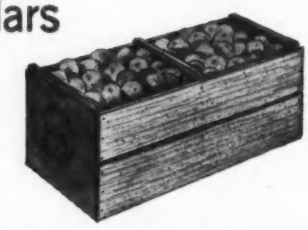

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Influence Of Various Rootstocks Of The Cold Resistance Of Scion Variety Of Citrus[1] . . .

GEORGE E. HORANIC AND
F. B. GARDNER
CROPS RESEARCH DIVISION
AGRICULTURAL RESEARCH SERVICE, U. S. D. A.

INTRODUCTION

Numerous observations in citrus plantings support the general belief that the rootstock frequently influences the cold resistance of the scion variety. In general these observations place the cold hardiness effect of the commonly used stocks in the descending order as follows: **P. trifoliata**, sour orange, Cleopatra mandarin, sweet orange, and Rough lemon. It is well known that this is the same order in which the unbudded stocks themselves tolerate low temperatures, and this agreement might lead one, perhaps erroneously, to the conclusion that a stock which is itself cold-resistant would automatically confer resistance on the scion variety. The relationship is probably not so simple. If, as generally agreed, cold resistance of the scion variety is determined chiefly by its degree of dormancy at the time of the low temperatures, then any rootstock which confers dormancy on the scion should thereby confer cold hardiness regardless of the hardiness of the stock itself.

Although there are many field observations of alleged rootstock influence on cold resistance, there are few based on experiments with strickly comparable conditions of exposure, variety, tree age and size, and cultural treatment. Webber (2) reported on the cold damage in an experimental block of 4-year-old Satsuma oranges on various rootstocks at Oroville, California. The rootstocks in this test block were rated according to their effects on cold resistance, with **P. trifoliata** at the top, followed in descending order by tangerine, citrange, sour orange, Sampson tangelo, grapefruit, and Rough lemon.

Cooper (1) reported on cold injury and recovery in his extensive rootstock plantings in the Rio Grande Valley during the severe winter of 1950-51. The first freeze came on December 7, 1950, and caused considerable defoliation and bark splitting on limbs up to one inch in diameter in a 3-year-old experimental planting of Red Blush grapefruit well replicated on 39 rootstocks. All trees were in a flush of new growth when the second freeze struck on January 31, 1951, and killed all trees to the banks. Many of these recovered by means of new shoots from below the banks; the percentage that survived on the different rootstocks was recorded. The survival data showed no consistent relation to the anticipated cold resistance based on previous observations of stock effect. Therefore, Cooper was inclined to the view that the survival is determined by the vigor and health of the trees and not by the inherent cold hardiness of the stock-scion combination. However, in the first and less damaging freeze of December 7 the degrees of defoliation and bark splitting were assumed to represent rootstock influence. Cooper's findings will be considered in some detail later in this paper in comparison with our own.

There is a marked relationship between the amount of cold damage and tree size; small trees suffer more than larger ones and open trees and those with a poor canopy more than those with dense foliage. These relationships are so pronounced that other factors such as rootstock effects are easily masked if trees of different size are being compared.

Table 1. Cold-injury ratings and tree size of Valencia orange tops on 41 rootstocks

Rootstock	Adjusted cold-injury rating	Unadjusted cold-injury rating	Tree size - (trunk circumference in cm.)
Bergamia sour orange	3.48	3.17	50.0
Florida sweet seedling	3.74	3.17	53.6
Trifoliata, large-flowered	3.94	5.83	29.1
Sampson tangelo	4.41	3.67	55.9
Bitter Sweet orange	4.51	4.17	50.5
Savage citrange	4.54	5.17	36.8
Trifoliata, small-flowered	4.64	5.33	26.3
Duncan grapefruit	4.70	3.83	57.9
Sunshine tangelo	4.81	4.17	55.0
Leonardy grapefruit	4.86	4.83	46.1
Hamlin sweet orange	4.91	4.67	49.0
Cleopatra mandarin	5.08	4.17	58.4
Ogami pummelo	5.14	5.67	38.3
Pina tangelo	5.30	5.17	47.5
Iran lemon	5.31	5.67	40.6
Dancy tangerine	5.32	4.67	54.7
Sauvage sour orange	5.33	4.67	54.9
Ponkan mandarin	5.34	5.00	50.4
Watt tangelo	5.40	4.83	53.7
Swatow mandarin	5.44	5.67	42.5
Sunki mandarin	5.50	6.33	34.1
Satsumelo, CPB 52010	5.56	5.67	44.1
Citrumelo, CPB 4475	5.62	6.17	38.0
Tong Dee pummelo	5.64	6.17	38.2
King orange	5.72	5.17	53.4
Sour orange No. 2	5.77	5.50	49.5
Minneola tangelo	5.82	5.50	50.1
Yalaha tangelo	5.85	6.00	43.5
Rangpur lime	6.03	6.33	41.5
Williams tangelo	6.03	6.00	46.1
Swannee tangelo	6.06	6.50	39.5
Citrangor, CPB 42681	6.21	8.00	20.6
Umatilla tangelo	6.25	6.17	46.8
Siamese pummelo	6.27	6.67	40.1
Seminole tangelo	6.43	7.17	35.4
Clementine tangerine	6.54	6.67	43.9
Kalpi lime	6.54	5.50	60.3
Cuban shaddock	6.56	6.83	41.9
Lakeland limequat	6.66	6.83	42.2
Tangor, CPB 653	6.76	6.00	56.3
Rough lemon	6.80	6.00	56.7
L S D, odds of 19 to 1	1.62	1.72	8.42
L S D, odds of 99 to 1	2.15	2.28	11.16

1/ Grateful acknowledgement is made to Mr. E. James Koch of the Biometrical Services Division, Beltsville, Maryland, for his help with the statistical analysis in this report.

The tree-size effect was very evident during the winter of 1957-58, and in the present study it was taken into account in the evaluation of the effect of the rootstock on cold resistance.

METHODS

The observations on cold damage reported were made on a 10-year-old experimental rootstock planting at Weirsdale, Florida, which was badly injured during several freezes in the winter of 1957-58. The planting consisted of a large number of rootstocks all budded with Valencia sweet orange, and planted in pairs in four replications. The land sloped uniformly to the south with the replications extending east and west across the slope. Trees in replicate 1 at the upper side of the slope were only moderately hurt by the cold, and the degree of injury increased with succeeding replications southward until practically all trees regardless of rootstock were killed to the ground in replicate 4. This last replicate was omitted from the data calculations.

No temperature records were made in the planting itself. Close to the upper and warmest side of the block the temperature dropped to 32°F. by 11:30 p. m. on the night of December 11, 1957, and continued to drop to 23° at 7:30 a. m. on December 12. On the following day, December 13, the temperature was 25°F. at 4 a. m. and 24° at 7:30 a. m. The lower portion of the experimental block was considerably colder during the second night, probably as much as 4° or 5°F. Several subsequent cold nights during the winter no doubt contributed to the final damage recorded.

On June 18, 1958, when there had been ample opportunity for the extent of the damage to become well defined, the trees were individually rated from 1 through 8, as follows:

1. A few terminals, not more than 12, killed back 6 to 12".
2. A few terminals, not more than 12, killed back 12 to 24".
3. As many as 24 terminals killed back to 24".
4. All periphery shoots dead 24 to 30" back.
5. All periphery shoots dead back to wood 1" in diameter.
6. Main branches and trunk killed to within 3' of the ground.
7. Main trunk below 3' showing some life.
8. Completely dead to the ground line.

The 8 categories were distinct, and the ratings made independently by two observers were in complete agreement. The average of these ratings for the 6 trees on each rootstock were adjusted for tree-size effect by an analysis of covariance in which the cold-damage score is the dependent variable and tree size (trunk circumference) the independent variable. In other words, the adjusted cold-damage ratings are those which would have obtained if all the trees in the experiment had been of exactly the same size.

RESULTS

Table 1 shows the tree size, the cold-injury ratings regardless of tree size, and the ratings adjusted for tree size. In this experiment the correlation coeficient expressing the degree of correlation between tree size and cold injury was - .67. The column headed "adjusted cold-injury rating" ranks all the stocks from the most cold-resistant (Bergamia sour orange) to the least resistent (Rough lemon) on the basis of all trees being the same size.

It is evident that the rootstock effect on cold resistance of the scion is very real even though the differences are statistically significant only when stocks widely separated in the ranked column are compared. Thus the differences between the ratings of the top 12 stocks are not considered to be significant, although all this group are significantly more cold-hardy than the trees on Rough lemon.

Mention has been made of the report by Cooper (1) on the cold injury ratings in a rootstock test block in Texas in which stocks were very similar to those in the present experiment. In fact, the seedlings for his test and for ours were grown from seed collected in Florida at the same time. A portion of each seed lot was eventually budded with Red Blush grapefruit in Texas and the remainder budded with Valencia orange in Florida. Cooper's rootstock field planting consisted of 4 replications of 3 trees each, a total of 12 trees, on each of 39 stocks. Following a freeze on December 7, 1950, when the trees had been 3 years in the field, Cooper rated each tree for the amount of bark splitting. He rated no splitting 0, splitting on small twigs 1, and that on large limbs 2. The similarity of the rootstocks in his experiment and ours permits an interesting comparison. All stocks common to both experiments are listed in table 2 in order of their cold-resistant effect on the scion variety.

Considering the difference in location, scion variety, age of tree, criterion of injury, and the winter of damage, there is a rather remarkable agreement in the order of the ranked cold resistance between Cooper's results and ours. With most of the stocks the position within the two ranked columns is very close. In no instance is the deviation as great as the limits of the statistical significance except in the case of Cleopatra mandarin. Cooper's

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Table 2. Comparison of the author's and Cooper's rating of cold damage on all citrus rootstocks used in both experiments

Author's rating - degree of wood killing		Cooper's rating - degree of bark splitting	
Rootstock	Rating	Rootstock	Rating
Bergamia sour orange	3.48	Hamlin sweet orange	.3
Florida sweet seedling	3.74	Sunshine tangelo	.6
Sampson tangelo	4.41	Bergamia sour orange	.8
Bitter Sweet orange	4.51	Bitter Sweet orange	.8
Savage citrange	4.54	Sauvage sour orange	.8
Duncan grapefruit	4.70	Sour orange No. 2	.9
Sunshine tangelo	4.81	Leonardy grapefruit	.9
Leonardy grapefruit	4.86	Pina tangelo	.9
Hamlin sweet orange	4.91	Watt tangelo	.9
Cleopatra mandarin	5.08	Williams tangelo	.9
Pina tangelo	5.30	Florida sweet seedling	1.0
Dancy tangerine	5.32	Savage citrange	1.0
Sauvage sour orange	5.33	Duncan grapefruit	1.0
Watt tangelo	5.40	Sunki mandarin	1.0
Sunki mandarin	5.50	Sampson tangelo	1.1
Citrumelo, CPB 4475	5.62	Dancy tangerine	1.1
Tong Dee pummelo	5.64	Citrumelo, CPB 4475	1.2
King orange	5.72	Rangpur lime	1.2
Sour orange No. 2	5.77	Thong Dee pummelo	1.2
Minneola tangelo	5.82	Minneola tangelo	1.2
Yalaha tangelo	5.85	Yalaha tangelo	1.2
Rangpur lime	6.03	Siamese pummelo	1.3
Williams tangelo	6.03	King orange	1.4
Suwanee tangelo	6.06	Umatilla tangelo	1.4
Umatilla tangelo	6.25	Kalpi lime	1.4
Siamese pummelo	6.27	Suwanee tangelo	1.5
Kalpi lime	6.54	Rough lemon	1.6
Rough lemon	6.80	Cleopatra mandarin	1.8
L S D, odds of 19 to 1	1.62	L S D not calculated	
L S D, odds of 99 to 1	2.15		

HYDROCOOLING STUDIES WITH FLORIDA CITRUS

(Continued from page 7)

17 days after packing. These examination periods were chosen as approximating the time at which oranges might be purchased at retail after several days in the store and then a further week corresponding to time in the customer's home, since most families purchase citrus on a weekly basis (6). At the first examination, the oranges were counted and the number of rots or of fruits with severe peel injury were recorded for each carton or bag. These fruits were then discarded. In the early experiments, the oranges were replaced in the cartons. Later, this procedure was changed, and after the first examination, the sample was placed in a wooden crate which was considered to approximate more closely conditions in the customers' homes. At the 17-day examination, rots and peel injuries were again recorded and the samples discarded. At these examinations, fruits were recorded as having peel injury only if the amount of disfigurement was considered to be bad enough to markedly detract from customer appeal. Because of their slower rate of decay, grapefruit were held for an additional week and examined at 10, 17, and 24 days from packing.

Gloss Examination.- Gloss (shine) readings were taken with a Photovolt glossmeter (12). This machine has been adapted so that it will read gloss on a spherical surface and the same fruit can be used for a series of readings. Ten gloss readings were taken on each fruit and 10 fruit were used per sample. With each experiment usually repeated five times, each final gloss reading was thus the average of 500 individual readings.

Standard procedure at the Citrus Experiment Station has been to hold fruit for gloss studies in open crates in a 70° F. constant temperature room. Additional values were also obtained by reading gloss on fruit from cartons or bags after the second (17-day) examination.

Presentation of Data

Records on the packinghouse experiments include wastage figures from examinations of 3,200 cartons of oranges, 1,200 examinations of bags of oranges and examinations of 300 cartons of grapefruit. Records of gloss readings are on a similar unwieldy scale. Because of this, values have been averaged within each experiment and then tabulated in an experiment station progress report. Tables throughout the text are re-capitulations from this report.

Table 3. Decay, Peel Injury, and Gloss of Valencia Oranges in Experiments Involving Hydrocooling, "Dowicooling", and 101A Wax. Averages from Five Experiments Carried Out Weekly from February 12 to March 12, 1958.

Treatments	Decay (percent)		Peel Injury (percent) Days from Packing		Glossmeter Reading			Gloss, Cartons
					Open Crates			
	10 days	17 days	10 days	17 days	0 days	7 days	14 days	17 days
Unwaxed, not cooled prior to packing	10.7	25.9	0.4	0.9	—	—	—	29.1
101A wax, not cooled prior to packing	6.4	18.0	0.5	1.7	39.5	37.6	35.5	39.0
Hydrocooled, then 101A wax	6.5	15.6	0.9	2.5	38.6	36.2	33.4	36.9
101A wax, then hydrocooled	4.3	10.3	1.6	4.1	39.1	37.0	33.8	37.0
Dowicooled, then 101A wax	2.2	8.0	1.1	4.1	—	—	—	39.5
101A wax, then Dowicooled	1.5	4.4	2.4	8.5	—	—	—	35.4

RESULTS

Series I: Early and Mid-season Oranges.- Ten experiments were carried out with early and mid-season oranges, the results of which are summarized in Table 1. The Flavorseal wax apparatus was not ready for the first hydrocooling experiment with Hamlin oranges, so for that one run, no wax was used. For all others, the oranges were waxed with Flavorseal wax prior to hydrocooling, Dowicooling, or (for the control) packing warm. After packing in cartons, all samples were stored at 70° F., the cartons of cooled oranges being placed in the insulated cabinets to retain the refrigeration effect for as long as possible.

Reference to Table 1 shows that both decay and peel injury of Hamlin oranges was increased by hydrocooling. These Hamlin oranges were degreened, and this was a very bad season for **Diplodia** stem-end rot in early, degreened oranges. Most of the very high losses in hydrocooled Hamlins were due to stem-end rot. Peel injury was very minor and the increase due to hydrocooling would have been of very minor importance commercially. Gloss was decreased slightly by hydrocooling, but the effect was not very marked and may have been attributable in part to the fact that on these early runs the fruit was handled more than was later found to be necessary.

Dowicooling of Hamlin oranges caused a very appreciable reduction in decay that persisted until the 17-day examination. There was again an increase in peel injury, but at a very low level. A rather similar reduction in decay was obtained when Dowicooling the Pineapple variety, but it was accompanied by a very serious increase in peel injury (to which this variety is extremely susceptible). This peel injury was so severe and appeared so promptly that the affected fruit were not removed at the 10-day examination as that would have drastically reduced the size of the sample.

The gloss of these Dowicooled fruits was very good, there being no consistent differences when examined at one and two weeks from treatment. Drying after Dowicooling caused a slight but consistent decrease in gloss.

Residues of Sodium o-phenylphe-

Table 2. Residues of Sodium o-phenylphenate and Losses from Subsequent Decay in Valencia Oranges from Various Hydrocooling and Dowicooling Procedures.

Percent Dowicide A in Hydrocooler Water	ppm. Sodium o-phenylphenate in oranges.[1]	Percent Losses from Decay	
		Days from Packing 10 days	17 days
Control (not hydrocooled)	0.9	6	37
0.0	0.9 ppm.	13	36
0.01	0.8 ppm.	16	39
0.01 (Rinsed)	0.9 ppm.	13	25
0.05	1.6 ppm.	8	39
0.05 (Rinsed)	1.1 ppm.	14	39
0.1	4.1 ppm.[2]	2	19
0.1	13.5b ppm.	1	28

[1] Residues expressed as parts per million o-phenylphenol on a whole fruit, fresh weight basis.
[2] Obvious, but unexplained, anomalous result.

nate.- The use of this chemical in the hydrocooler water brought up several questions. These included: Were there residues of sodium o-phenylphenate in the fruit? If residues were present, were they within the legal tolerance of 10 ppm. as o-phenylphenol (15)? Could a concentration of sodium o-phenylphenate be found so that a measure of decay control could be achieved without leaving any significant residue in the fruit?

Four analyses were carried out[a] on Dowicooled Hamlin oranges, the sample being three oranges in each case. The residues found were 3.7, 3.5, 3.8, and 4.4 parts per million. These residues are well within legal tolerance (15), but are high enough to involve the special labeling regulations that the Food and Drug Administration call for when residues of postharvest fungicides are detectable.

A small scale experiment was set up using eight samples of 105 fruit each and hydrocooling with increasing amounts of Dowicide A in the water. In order to see whether the residues could be readily removed, double samples were used, one of which was rinsed thoroughly with a hose after hydrocooling. Five fruit from each sample were removed for analysis and the rest stored in cartons for six days at 60° F. and thereafter at 70°F. Residues and losses from decay are shown in Table 2. It is apparent that residues of approximately 4 ppm. have to be tolerated in order to achieve worthwhile decay control and it is equally apparent that such residues cannot be rinsed off.

[a] These samples were air mailed to the Dow Chemical Company's laboratories at Midland, Michigan, for analysis.

Table 4. Effect of various treatments associated with hydrocooling on decay, peel injury and gloss of Valencia oranges. Averages from five experiments each using ten cartons per sample.

Treatment		Percent losses from decay		Percent losses from peel injury		Gloss meter readings	
No.	Description	10 days	17 days	10 days	17 days	Initial	17 days
1	Control: Flavorseal, no wetting, no cooling. Cartons.	2.3	10.4	1.1	5.3	42.3	38.5
2	Half-hour flood with room temperature water. Flavorseal. Cartons.	2.6	13.4	1.7	4.5	42.3	38.2
3	Flavorseal, hydrocool, packed in cartons without drying	0.5	11.0	2.9	6.0	40.1	37.7
4	Flavorseal, hydrocool, dried, packed in cartons	0.9	11.2	1.9	6.3	40.2	36.8
5	Flavorseal, Dowicool, dried, packed in cartons	0.1	3.9	3.1	10.8	39.8	37.3
6	Flavorseal, Dowicool plus hexamine, dried, packed in cartons	0.1	3.2	5.1	13.6	40.6	39.0
7	Dowicool plus hexamine, 101A wax, dried, packed in cartons	0.02	1.9	2.9	10.4	38.6	36.8
8	Flavorseal, packed in wire-bound box, air-cooled rapidly	0.2	7.1	4.2	7.5	42.3	38.6
	Statistical significance:						
	Picking dates	n.s.	**	*	**	-	-
	Treatments	*	**	n.s.	*	-	-

Series II. Valencia Oranges—Water Wax Experiments.- The Flavorseal machine was unavailable for five weeks and during this period a series of experiments using Lake Alfred Wax 101A (11) was carried out. Unlike solvent waxes, water emulsion waxes can be applied to cold damp fruit and hence might be suitable for waxing after hydrocooling rather than before. The 101A wax contains sodium o-phenylphenate and hence an additional unwaxed control had to be used in order to isolate the effect of the fungicide in the wax.

As well as the two controls (waxed and un-waxed), hydrocooling and Dowicooling were used with the added variable of samples waxed before and after cooling. Ten cartons were used per sample. There were six treatments in the experiment which was repeated five times. Thus 300 cartons in all or approximately 30,000 oranges were involved.

After packing, the cartons were stored in insulated containers at 60° F. for six days and then removed to 70° F. for the rest of the experiment.

The results of this experiment are

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Table 5. Decay, peel injury and gloss of Valencia oranges hydrocooled or Dowicooled prior to packing in polyethylene bags as contrasted with mesh bags cooled after packing.

Treatment	Decay				Percent peel injury		Gloss at 17 days
	Percent decayed fruit in each treatment		Percent bags having one or more rots				
	10 days	17 days	10 days	17 days	10 days	17 days	
Mesh bags, air-cooled after packing	0.38	2.4	5.8	34.8	0.15	1.2	37.0
Hydrocooled, polyethylene bags	1.03	7.3	11.6	56.6	0.1	2.2	34.3
Dowicooled, polyethylene bags	0.13	4.3	1.2	48.0	0.5	3.7	34.8
Statistical significance							
Picking dates	n.s.	n.s.	n.s.	*a	n.s.	n.s.	n.s.
Mesh vs. H/C poly	n.s.	*	n.s.	*	n.s.	n.s.	*
Hydrocool vs. Dowicool	n.s.	*	n.s.	*	*	n.s.	n.s.

a Indicates a trend, significant at the 5% level, for decay to decline with progressing picking date from April 30 to May 21, 1958.

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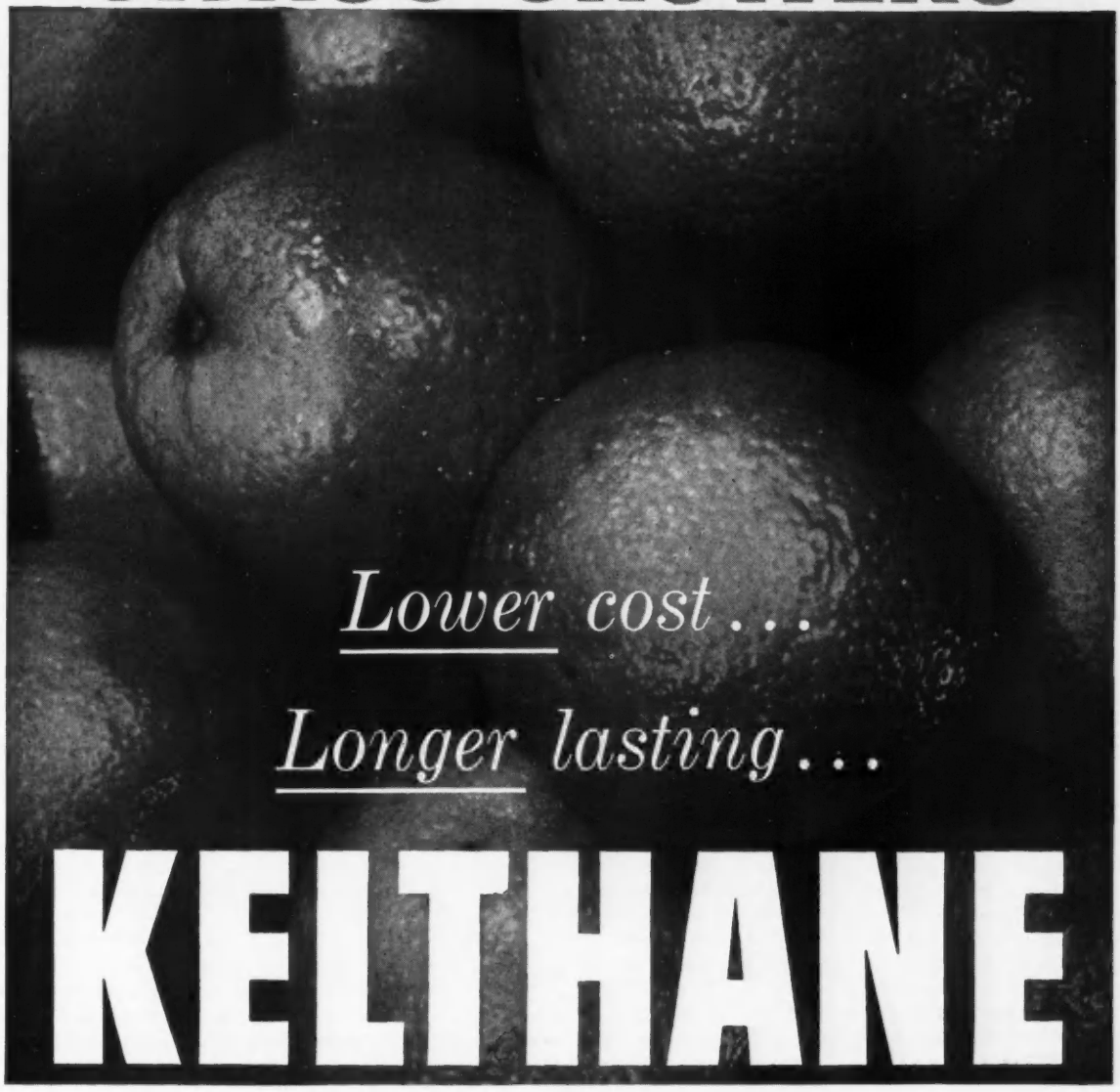

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shown in Table 3. The losses from decay show clearly the effects of the Dowicide A both in the wax and in the Dowicooling. In the control samples (packed warm) use of the 101A wax reduced decay by 40 percent at the 10-day examination and by 30 percent at 17 days from packing. Comparing Dowicooling and hydrocooling, losses were lower after Dowicooling in all four possible comparisons. Waxing before cooling resulted in lower losses in four out of four possible comparisons and the most favorable treatment with regard to decay control was waxing with 101A prior to Dowicooling. This treatment resulted in 86 percent reduction in decay at the 10-day examination and 83 percent reduction at 17 days from packing.

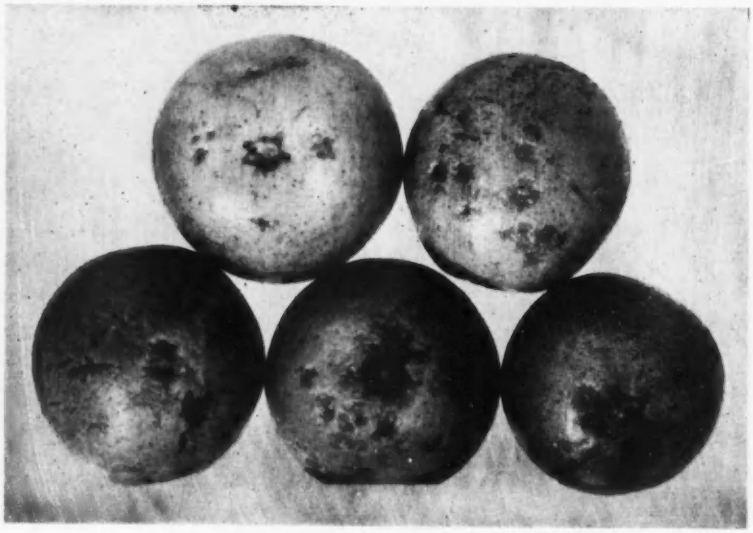

Figure 3. Peel injury of Valencia oranges cooled by direct exposure to a 36° to 38° F. airstream. (Photo by Harriet Long)

Peel injury was comparatively minor, but the tendencies revealed were not encouraging. There was a slight increase in peel injury due to waxing. There was a very definite increase due to hydrocooling. This was further aggravated by the use of 0.1 percent Dowicide A in the cooling water, but this could be minimized by waxing after Dowicooling rather than before.

Gloss readings were rather more encouraging inasmuch as the previous report (2) that 101A wax could withstand hydrocooling was confirmed. There were no significant differences between gloss readings on oranges waxed before hydrocooling as compared with those waxed after. Gloss was retained better in closed cartons than in open crates and the most persistent gloss was with Dowicooling followed by waxing. In this latter treatment, the higher shine was very apparent to the unaided eye when the cartons were opened for examination.

Lake Alfred Wax 101A is only one of a number of water waxes available and the results are not necessarily transferable. However, this series of experiments does indicate that: (i) water wax can withstand hydrocooling; (ii) this wax emulsion can be applied either before or after hydrocooling; (iii) once labeling regulations are incurred there is a definite advantage in adding another fungicidal treatment (providing, of course, that legal residue tolerances are observed).

Series III: Valencia Oranges—Eight Treatments.- In the five weeks from March 19 to April 16, 1958, inclusive, a comprehensive experiment was repeated five times. The treatments were as follows:

1. Control. Waxed with "Flavorseal" and packed in cartons without cooling.

2. Subjected to a half-hour flood with room temperature water (to separate the effect of wetting during hydrocooling from that of cooling). Waxed with "Flavorseal", packed in cartons without cooling.

3. Waxed with "Flavorseal", hydrocooled, packed in cartons without drying.

4. Waxed with "Flavorseal", hydrocooled, dried, packed in cartons.

5. Waxed with "Flavorseal", Dowicooled, dried, packed in cartons.

6. Waxed with "Flavorseal", Dowicooled with 0.1 percent Dowicide A and 0.05 percent hexamine, dried, packed in cartons.

7. Dowicooled as in 6, above, then waxed with 101A fungicidal wax, dried, packed in cartons.

8. As for Treatment No. 1, but packed in 4/5-bushed wirebound boxes and then placed immediately in front of a 38°-40° F. air blast in an attempt to separate the effect of rapid cooling during hydrocooling from that of wetting.

Several of the above treatments involved drying the fruit with hot air after hydrocooling or dipping in wax emulsion and then drying. Care was taken that the timing was such that the hydrocooled fruit was not in the hot air tunnel after drying was completed. With this precaution, it was found possible to dry such cold fruit with only a seven to eight degree increase in albedo (peel) temperature and less than one degree rise in pulp (center) temperature. This is shown in Figure 1.

Treatments 1 and 2 were held in the corridor until late afternoon (as equivalent to being "set back" in the packinghouse) and then placed in insulated cabinets in the 60° F. storage. Treatments 3, 4, 5, 6, 7, and 8 were placed in 40° F. storage after packing. Two days later they were removed to insulated cabinets in the 60° F. storage. On the sixth day after packing, all eight treatments were removed to the 70° F. storage and held there for examination. This series of moves was to seek an approximation of the temperature changes that would occur in commercial transit. For the actual pulp temperatures obtained see Figure 2.

Table 4 shows the average values from the five repetitions of this experiment. Ten cartons were used per sample, containing approximately 100 fruit on the average. Thus, each decay or peel injury figure is an average of 50 values derived from 5,000 fruit. Each gloss reading in this table is the final average of 500 readings. Decay was much lower than in the previous Valencia experiments, but no reason is known for this. Consistent differences between treatments were, however, obtained.

Comparing Treatments Nos. 1 and 3, it is apparent that hydrocooling followed by cool "in-transit" temperatures resulted in a good reduc-

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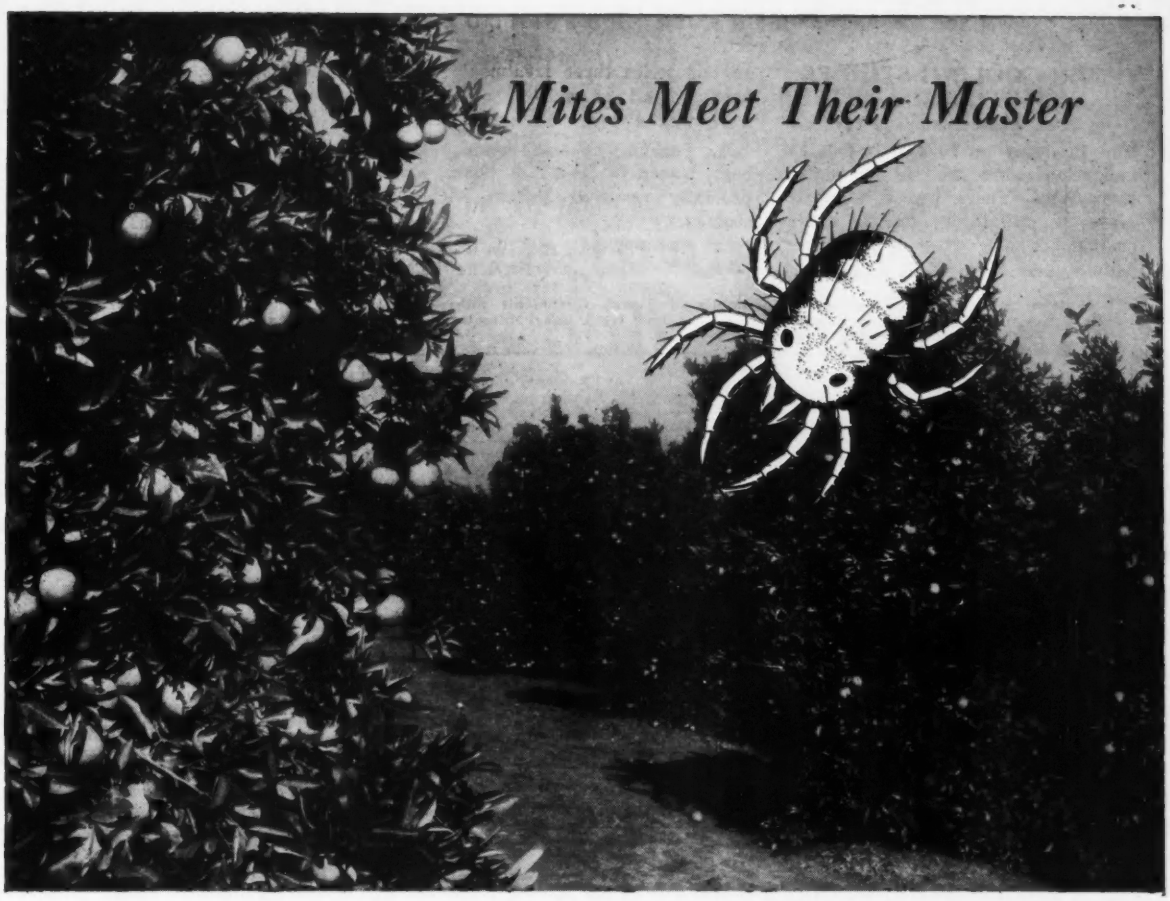

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HYDROCOOLING STUDIES WITH FLORIDA CITRUS

(Continued from page 14)

tion in decay up to the 10-day examinations, but no decay control thereafter. There was a slight increase in peel injury due to hydrocooling. Drying after hydrocooling, had no consistent effect upon decay or peel injury. The use of Dowicide A in the hydrocooler water (Dowicooling) reduced decay very sharply, but at a cost of approximately doubling peel injury. Adding hexamine did nothing to help, although it is known to check the phytotoxic action of o-phenylphenate at higher temperatures (7). Using the fungicidal 101A wax on Dowicooled oranges (Treatment No. 7) reduced decay to an almost negligible amount and there was no further increase in peel injury. These fruit appeared bright and shiny, but glossmeter readings were lower than in either of the comparable Flavorseal samples or in the equivalent treatment (without hexamine) in the previous experiment.

Table 6. Effect of Dowicooling on Wastage of Marsh Grapefruit Subsequently Packed in Fiberboard Cartons and Held under Simulated Transit and Market Conditions.

Treatment	Percent Decay at 19 Days from Packing		Percent Loss from Peel Injury	Total Wastage (percentage)
	S.E.R.[1]	Pen.[2]		
Control (packed without cooling)	6.1	1.8	0.0	7.9
Dowicooled, not dried	0.7	0.6	4.2	5.5
Dowicooled and dried	2.6	1.2	1.8	5.6

[1] S.E.R., Stem-end rot.
[2] Pen., Penicillium

Comparison of Treatments Nos. 1, 2, 3, and 8 indicate that the consistent increases in peel during hydrocooling trials is due to temperature effects rather than to the wetting effect. Air cooling cannot be as fast as hydrocooling due to the poor qualities of air as a heat exchange medium. Not only was peel injury increased significantly by comparison with the control samples, but the lesions were particularly severe and were distributed over the whole surface of the fruit (see Figure 3) rather than the more usual stem-end pitting common to this variety (3). Decay was lower in this air cool treatment than it was in either the hydrocooled treatment or in the control. This experiment affords evidence that when oranges are susceptible to peel injury the harmful effects of too rapid cooling can show up in the form of aggravated peel injury before there is any increase in subsequent decay.

Series IV: Valencia Oranges in Mesh and Polyethylene Bags.- In this series three treatments were used, in all of which the oranges were waxed with "Flavorseal".

1. Packed in eight-pound mesh bags, placed in open field boxes, and promptly removed to the 40° F. storage.

2. Hydrocooled, packed in eight-pound ventilated polyethylene bags, the bags were then packed in "bagmaster" cartons which were removed to the 40° F. storage.

3. As for Treatment No. 2, except that 0.1 percent Dowicide A was used in the hydrocooler water.

The polyethylene bags were supposed to have 40 ¼-inch holes per bag. However, many of these holes failed to punch out and actual ventilation ranged from 40 down to as few as 20 holes.

Due to a shortage of fruit (the season being curtailed by the freezes) this series was repeated four times instead of the usual five. Fifty bags were used for each sample. The number of oranges in each bag varied from 10 to 15 depending on size of fruit. Thus each figure in Table 5 represents the average from 200 bags or 2,000 to 3,000 fruits.

After two days at 40° F., all samples were removed to 60° F. where each treatment was stored in a different insulated cabinet. At six days from packing, they were removed to a 70° F. room.

Examinations were at the usual 10 and 17 days from packing, a record being kept of decay and peel injury in each bag, as well as in each treatment. After the 10-day examination the oranges were replaced in the same bags, the bagmaster cartons were, however, discarded and the bags stored thereafter in open crates. Pulp temperature records were kept but are not presented here as they were essentially similar to those in Treatments No. 3 (hydrocooled) and No. 8 (aircooled) in Figure 2.

These late Valencia oranges proved to be extraordinarily resistant to decay and the percentage lost due to decay was very low. References to Table 5 shows that decay up to 10 days from packing was so low as to be almost negligible, particularly in the Dowicooled samples. By the time of the 17-day examination this advantage had been lost and there is significantly higher loss in the hydrocooled oranges. With any type of consumer package a paramount consideration is "How many customers get one or more rots in the package?" For this reason Table 5 also presents this data in terms of the percentage of bags having one or more rots. Expressed in this manner, it is seen that nearly six percent of the mesh bags have one or more rots at time of purchase. This is exactly doubled by using hydrocooled oranges in polyethylene bags. Dowicooling reduces this figure to little more than one percent, but the advantage

(Continued on page 18)

Table 7. Effect of hydrocooling on decay, peel injury and gloss of Marsh grapefruit.

Treatment	Percent decay			Percent peel injury			Gloss meter readings		
	Days from packing			Days from packing			Days from packing		
	10	17	24	10	17	24	0	14[1]	17[2]
Control (not hydrocooled)	3.4	8.5	14.9	0.9	0.9	1.2	51.5	42.0	45.3
Hydrocooled	7.7	19.2	31.7	1.6	2.9	6.2	47.1	38.3	41.0
Increased wastage due to hydrocooling	127%	114%	113%	78%	222%	417%			

[1] Held in open crates at 70° F.
[2] Removed from cartons at 17 day examination.

Table 8. Percent Decay in Hamlin Oranges from Various Treatments. Averages of Three Trials[1], All Samples Examined after Storage at 40° F. for Four Days and then at 70° F. until 14 Days from Picking.

Treatment (All packed in polyethylene bags)	Average decay	Percent decay control	Percent of bags having one or more rots
No fungicide	18.0	—	73
Dowicide A-hexamine	5.3	70%	33
101A wax	2.7	85%	27

[1] Degreening treatments: Picked November 8, 1955, degreened 48 hours.
Picked November 29, 1955, degreened 24 hours.
Picked December 3, 1955, not degreened.

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A few pounds of magnesium, at just a few cents a tree, can make the difference between a bumper yield and no yield at all. That's the vital importance of magnesium to Florida citrus growers. And that's why you can't afford to take the chance of buying so-called "complete" fertilizers without Sul-Po-Mag* (double sulphate of potash-magnesia).

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(1) Nearly all Florida citrus soils traditionally lack adequate available magnesium and need regular special applications of this vital element.

(2) The average citrus tree removes 1 ½ to more than 3 pounds of magnesium from the soil per year. That's a lot of magnesium, when you consider the lack of magnesium reserve in Florida soils.

(3) Leaching also contributes to the need for replacement of all nutrients vital to the health and production of citrus trees. It is a continuous process of nature in all years.

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To maintain minimum available magnesium, average Florida citrus soils require an annual application of 0.2 to 0.4 lbs. water soluble magnesium (magnesium oxide equivalent) per box of fruit . . . for example, 1.6 to 3.2 lbs. for an eight-box tree.

By checking the guaranteed analysis of the fertilizer you buy, you can quickly determine the application rate necessary to supply this magnesium.

How to Detect Shortage

The first visible evidence of magnesium deficiency shows up on leaves near the fruit. Irregular yellow blotches appear along the midrib of the leaf, while the leaf veins remain green. Such trees will soon lose foliage and young wood. They'll lose yield, size, and quality of fruit. But the big risk is that, by the time deficiency symptoms appear, you've already suffered severe profit losses — often for several years.

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HYDROCOOLING STUDIES WITH FLORIDA CITRUS

(Continued from page 16)

does not continue in the week after purchase. This table illustrates the importance of protective measures when selling bagged fruit. Even with decay abnormally low as it was in these Valencias, at least one-third of the customers could have been expected to get one or more rots.

Peel injury was also abnormally low, but the small amount that was present increased with hydrocooling and even more so with Dowicooling. These results are paralleled by those observed in the commercial shipping tests reported below.

The effect of hydrocooling and Dowicooling on gloss was more in these bagged fruit than had been the case with oranges packed in cartons, even though the hydrocooled fruit in polyethylene bags was particularly firm and fresh looking. The decrease in gloss was not, however, enough to detract from their appearance as seen through the clear polyethylene bags. The fruit from the mesh bags was obviously softer, but still gave a higher gloss meter reading.

Series V: — Grapefruit.- An initial test of hydrocooling with Marsh grapefruit was made in mid-December, 1957. At this time, experiments with oranges and tangerines had to be discontinued until freeze damage could be assessed, but sound grapefruit were still available. A small scale experiment was conducted using only 24 cartons divided into three treatments which were: Control; Dowicooled not dried; and Dowicooled and dried prior to packing.

This fruit came in from the grove with a pulp temperature of 58° F. After hydrocooling for 30 minutes the average pulp (center) temperature was still 54° F. After packing in fiberboard cartons, these grapefruit were stored at 70° F. in the insulated containers. Losses from peel injury and decay are shown in Table 6. Decay was low in the control treatment, being less than eight percent at 19 days. This was reduced to almost negligible levels by the Dowicooling, but at the expense of an appreciable increase in peel injury.

Further tests were deferred until April and May, 1958, when a hydrocooling experiment with Marsh grapefruit was repeated on five successive weeks. Two treatments only were used, control and hydrocooled, with 10 cartons per sample. Thus, the figures in Table 7 represent the average from five trials involving a total of 100 cartons.

Cooling was more effective than in the December experiment, but was still not very successful. Even after one hour in the hydrocooler, the center temperature of the large sizes was not down to 60° F. This is shown in Figure 4.

After packing, these grapefruit were put through the same holding conditions as the oranges in the Series IV experiments. Table 7 shows the results obtained. There are no benefits from hydrocooling. Decay and peel injury were increased and gloss decreased. The peel injury took the form of round sunken areas about the size of a 10-cent piece which turned black in storage. Typical low temperature storage pitting such as is commonly encountered with grapefruit (4) was not observed.

DISCUSSION

Hydrocooling has not been as successful as was originally hoped. There is evidence that, if the temperature of the packed fruit is not allowed to rise too much in transit, excellent arrival condition of hydrocooled fruit can be expected. However, the subsequent decay after the fruit is allowed to come to room temperature, as in stores and homes,

[4] These analyses were made by Mr. Martin Slade of the Food Machinery and Chemical Corporation using an experimental apparatus supplied by the Dow Chemical Company.

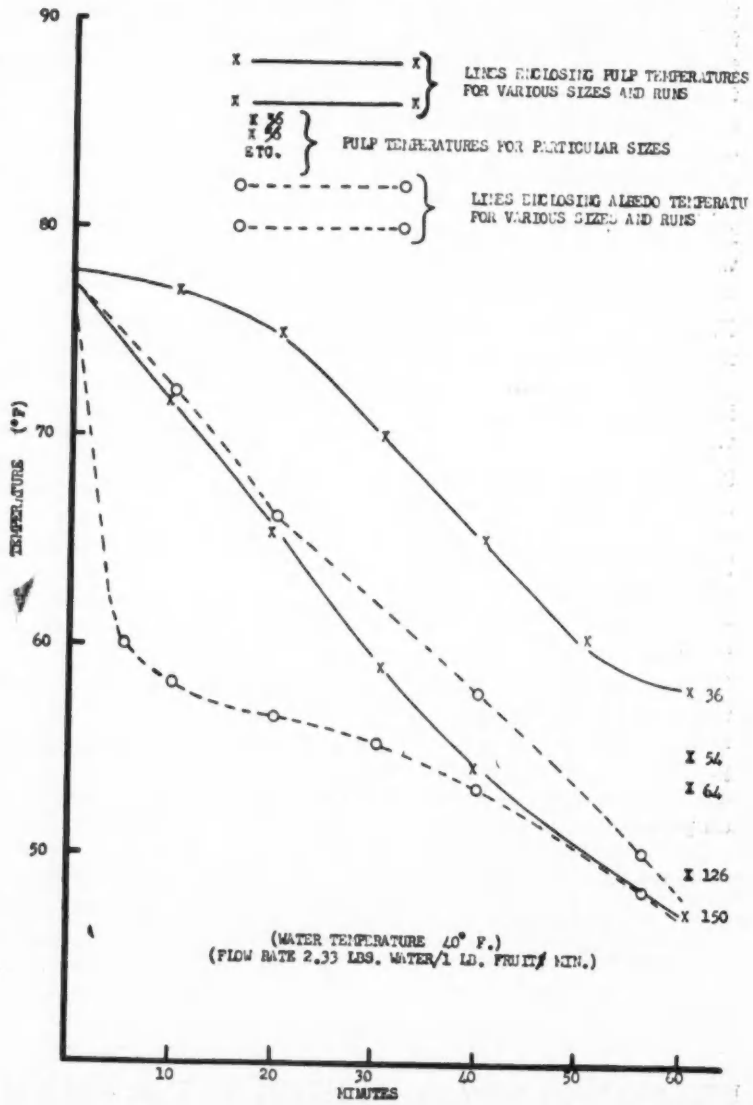

Figure 4. Internal temperatures of Marsh grapefruit during attempted hydrocooling.

can exceed that of the non-hydrocooled fruit. Peel injury, particularly of Pineapple oranges, has been increased by hydrocooling.

Use of Dowicide A (sodium o-phenylphenate) in the hydrocooler water (Dowicooling) definitely checks decay, although this effect did not persist for long enough when the fruit was packed in polyethylene bags. The maintenance of the concentration of o-phenylphenate in experimental runs was not a problem as the tank was re-charged for each experiment. Dowicooling was also used in the two commercial packinghouses and in one of them a series of analyses[4] revealed that the concentration of o-phenylphenate decreased very rapidly. This was later traced to precipitation as o-phenylphenol apparently due to reaction with atmospheric carbon dioxide. This could probably be prevented by raising the pH to about 11.0, but the season was over before this could be tried. The degree of decay control obtained by Dowicooling is certainly no better than can be obtained with the far cheaper Dowicide A-hexamine process (7). As evidence of this attention is drawn to Table 8 which shows hitherto unpublished results from the Citrus Experiment Station obtained with the use of Dowicide A-hexamine and with Lake Alfred 101A fungicidal wax on degreened Hamlin oranges subsequently packed in polyethylene bags. Despite the known tendency of such bags to increase decay (4,9), wastage was decreased by 70 to 85 percent.

The degree of decay control by Dowicide A-hexamine is encouraging, nevertheless, re-examination of Table 8 shows that even when decay was reduced by over 85 percent, up to one quarter of the bags could still contain one or more rots at two weeks from date of picking. Moreover, the use of fungicides alone does not remedy the stale flavors that can result from fruit being held in warm closed containers. Because of this cooling, either before or after packing, is still necessary, even if decay is controlled with fungicides.

The authors, therefore, believe that efforts to obtain more efficient cooling methods should continue, since the results reported here do not indicate that hydrocooling in its present form is necessarily the final answer.

ACKNOWLEDGEMENTS

The Citrus Container Institute contributed financial assistance in the necessary modifications to the Citrus Experiment Station packinghouse. Acknowledgement is also due to Mr. Orrin Thomas, Mr. Frank Cowart, and Mr. V. B. Dacy who assisted in this work and to Roper Growers Cooperative and Spada Fruit Sales, Inc.

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The Florida Citrus Exchange will ship a substantial order of canned orange and grapefruit juices, and grapefruit sections, to the Far East early in December, according to H. N. Benson, Exchange export manager. He said that the shipment will leave Tampa on Dec. 2nd, aboard the Norwegian freighter FERNSEA bound for Hong Kong, from where the citrus products will be trans-shipped to Singapore. The purchase was made by a large Singapore super market serving a part of the populous Malayan island.

Influenza is one of the more than 80 diseases that can be transmitted from man to animals.

Unfruitfulness In The Orlando Tangelo

A. H. KREZDORN AND
F. A. ROBINSON
CITRUS EXPERIMENT STATION,
LAKE ALFRED, AND
FLORIDA AGRICULTURAL EXPERIMENT STATION, GAINESVILLE

The Orlando (Lake) tangelo, a hybrid of Bowen grapefruit with Dancy tangerine, has in recent years become important as an early season specialty fruit. Of considerable concern to the grower has been the unfruitfulness commonly associated with this variety, and the widespread nature of the problem is indicated by the frequent inquiries, concerning possible remedial measures, which have been received by the Citrus Experiment Station.

Research was initiated in the summer of 1957 to determine the cause of the unfruitfulness and to devise means for increasing yields. Subsequent work showed that the unfruitfulness and low yields were due to the lack of strong, consistent parthenocarpy coupled with sexual self-incompatibility, and that fruiting could be induced by cross-pollinating the Orlando with the appropriate variety.

Materials and Methods

Survey Work.—A preliminary survey was made of unfruited and fruitful Orlando groves in the summer of 1957 to determine if there were any apparent reasons for the lack of fruiting.

In 1958 a large number of Orlando groves bordering or interplanted with other varieties were evaluated as to the size of crop and seed content to determine any possible influence of cross-pollination. Based on visual observations, the size of the crop was arbitrarily estimated as satisfactory, fair, or poor. Seediness was determined from a random sample of 25 fruit. Only Orlando trees immediately adjacent to the other varieties were used in evaluating possible crossing, and only Orlando trees definitely isolated from these varieties were used in evaluating selfing.

Natural Selfing and Malformed Flowers.—Systematic inspections of a number of Orlando groves were made throughout the season to determine the extent of naturally occuring self-pollination and the number of malformed flowers.

Pollen Germination. — Flowers of the Orlando and several other variaties were collected from six locations in Polk and Lake counties. Using the hanging drop technique, pollen from freshly opened flowers was germinated at room temperatures in a media of 20 percent and one percent agar in tap water. Then the percentages of germinating pollen grains were caluculated from counts made after a period of 36 hours. The tests were not run simultaneously.

Pollination Experiments.—A series of hand self and cross-pollinations were made on two trees at the Citrus Experiment Station (Polk County) and on 12 trees at both the Hartle and Williams groves (Lake County). Trees at the Experiment Station were about 20 years old, and had a record of satisfactory fruiting. Both the 89 acres of 9-year-old trees in the Hartle grove and the 30 acres of 6-year-old trees in the Williams grove were in excellent condition and larger than orange trees of comparable ages, but had records of extremely poor yields.

At the Experiment Station and the Williams grove, only leafy inflorescences (flowering shoots) of Orlando were used. Just prior to anthesis all but one flower was removed from each shoot, and the flowers then emasculated and depetaled. A portion of the pistils were left unpollinated and the others polinated by daubing them with freshly opened flowers of the appropriate variety. Then, in order to exclude foreign pollen, the pistils were covered with aluminum foil caps which were removed at the end of the bloom period. At the Williams grove, a portion of the emasculated and pollinated flowers were not capped, and a group of open pollinated flowers were also included as a treatment.

At the Hartle grove, using a large variety of pollens, the work was carried out in a solid block of Orlandos during the morning and on days when bee activity was negligible or lacking. Freshly opened flowers were emasculated, depetaled, and pollinated, but not capped. Assuming that bees do not visit emasculated and depetaled flowers, and that wind polination is not a factor, the above safeguards were considered sufficient to prevent natural crossing. Many flowers were naturally selfed, but this was considered as more nearly simulating field conditions and not as faulty procedure. Both leafy and leafless inflorescences were used. With the former, all but one flower were removed from each of two adjacent flowering shoots; one was crossed and one was selfed. Where leafless inflorescences were used, all but two or four flowers were removed from the flush of growth (twigs) on which the flowers were borne; half of the flowers on each twig were crossed and half were selfed. At any given flower position, equal numbers of flowers were either crossed or selfed.

Distance from the Pollinizer.—A block of 11 rows of young (6-7 feet high) Orlando trees located between Temple and Valencia groves was used to determine the relation of the distance from the pollinizer to the fruiting and seediness of the Orlando. On the tree counts were made of the number of fruit on each of 10 randomly selected trees from each of the 11 rows. Random samples of Orlando fruit were then taken from each row and the seeds counted.

Results and Discussion

In the preliminary survey in 1957, it was noted that adjacent to certain varieties the Orlando fruited well and was seedy. On trees isolated from these varieties the fruiting was usually (not always) poor and the fruit was relatively seedless. This complemented independent work by the junior author (5) who found no difference in the yield of Orlando trees caged with or without bees, but who did induce fruiting with a limited number of cross-pollinations.

These observations and results were not conclusive, but suggested further investigations along these lines.

Parthenocarpy.—In its narrowest sense, parthenocarpy is defined as the ability of a plant to develop

(Continued from Page 22)

[1] Florida Agricultural Experiment Station Journal Series No. 812.

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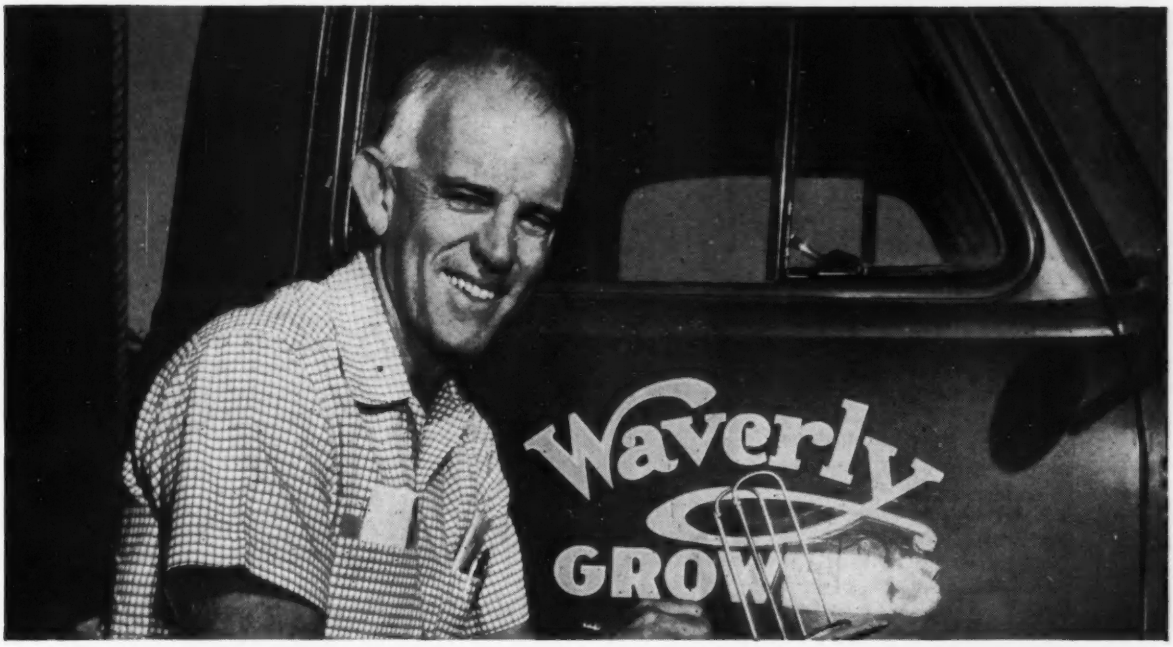

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158411

UNFRUITFULNESS IN THE ORLANDO TANGELO

(Continued from Page 20)

fruit without sexual fertilization. More broadly, it is the ability to produce fruit without seeds.

Evidence that the Orlando is not strongly parthenocarpic is given in Table 2. At the Experiment Station no fruit resulted from 100 unpollinated flowers while 84 very seedy fruit developed from 100 comparable cross-pollination. The seed count of samples of fruit from all locations indicated that the relatively large number of fruit resulting from hand crossing was accompanied by seediness. Also, Fig. 1 shows a general relationship of fruiting and seediness under conditions of open cross-pollination.

On the other hand, the two fruits resulting from hand self-pollinations at the Hartle grove contained only a few rudimentary seeds. The survey data in Table 3 show that, while most of the trees having satisfactory yields were seedy, some were producing good crops of seedless fruit. Furthermore, a few seedless fruits can be found on almost any Orlando tree, and some unfruitful blocks occasionally produce large seedless crops.

Thus, the Orlando is best described as weekly or erratically parthenocarpic.

Sexual Incompatibility.—The inability of a variety having functional pollen and ovules to produce fruit following selfing is termed lef-incompatibility. It is not to be confused with self-sterility, the inability to produce seeds when selfed regardless of the reason.

That Orlando pollen is functional is indicated by pollen germination tests (Table 1). This is substantiated by the data of Mustard et al. (3) and the production of viable hybrid Clementine seeds following cross-pollination with Orlando by United States Department of Agriculture plant breeders (1).

The ability of the Orlando to produce seeds, which has already been shown in the discussion on parthenocarpy, is conclusive evidence of functional ovules. Also, Robinson (6) in 1940 noted the seediness of Orlando when grown in mixed plantings, and recommended planting this variety in solid blocks to reduce the seediness.

Table 2 shows that at all locations hand self-pollinations resulted in very little fruit. Only two fruits resulted from 1,050 self-pollinated flowers. Also, the survey data in Table 3 shows that when isolated from other varieties the Orlando often, but not always, yields poorly. Flowers on these trees can be considered as selfed since it was determined by systematic observations throughout the season that the Orlando blooms heavily and produces perfect flowers which are naturally selfed.

Thus, despite functional pollen and ovules, and under a wide range of environments, the Orlando commonly, but not always, fails to develop fruit when selfed, and self-incompatibility is shown as an important factor in the unfruitfulness common to this variety.

Effects of Cross-pollination. — Data in Table 2 show that at all locations and with all pollen varieties used, cross-pollinations resulted in a large increase in fruiting as compared to the self-pollinated checks. Strikingly, 1,050 cross-pollinated Orlando flowers produced 645 fruits, while a similar number of comparable selfed flowers produced only two. Furthermore, the many thous-

(Continued on Page 24)

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Influence Of Various Rootstocks Of The Cold Resistance Of Scion Variety of Citrus

(Continued from page 10)

placement of Cleopatra at the bottom of his list, even below Rough lemon, is in sharp contrast with our relatively high rating of this stock and is contrary to all orchard observations of its cold resistance. Apart from this glaring exception, the two rankings support each other within rather close limits.

DISCUSSION

It should be pointed out that Cooper (1) presented data not only on the degree of bark splitting as influenced by rootstocks but also on the degree of defoliation following the same cold period. We arbitrarily selected the bark-splitting data for comparison with ours because of the agreement in rootstock performance. Cooper's defoliation data bear little or no similarity to his bark-splitting data and raise the question whether defoliation, usually considered a criterion of the amount of cold injury, is a reliable index. We can offer no logical explanation of this seeming paradox and can only point to our wood-damage ratings and to Cooper's bark-splitting estimates as agreeing far beyond the element of chance.

The adjusted cold-injury ratings in table 1 support, in the main, the belief that cold-resistant rootstocks tend to induce cold resistance in the scion variety. There are, however, a number of exceptions to this generalization. For example, Clementine tangerine, a rather cold-hardy variety itself, is near the bottom of the list when used as a rootstock; the sweet oranges rank high as rootstocks but as scion varieties they are not as cold-hardy as many of the varieties ranked much lower. Table 1 discloses a number of other such inconsistencies. Thus it appears that a cold-susceptible rootstock variety may induce a considerable degree of cold resistance in the scion and, conversely, a cold-resistant stock may result in cold susceptibility. No doubt the evaluation of the cold resistance of a rootstock itself is, at least in part, an expression of its degree of dormancy even though there are many instances of inherent differences in cold resistance between stocks unrelated to their dormancy.

From a practical standpoint there is no doubt that the use of rootstocks near the top of table 1 would result in more cold-resistant trees than the use of rootstocks near the bottom of the list. Because of the numerous varieties which make each instance different from every other instance, it is not possible to state how such an advantage, in terms of temperature degrees, might thus be gained. It is obvious that the temperatures in some winters or in some locations might be low enough to overcome the few degrees' advantage conferred by a cold-resistant stock. However, in many cold periods this advantage is of real practical value. In this experiment the trees on the most resistant stocks in replicate 1, in the warmest portion of the plot, were almost uninjured, whereas in replicate 4, at the low portion of the plot, the same rootstock combinations were killed to the ground. It is probable that the temperature differential from top to bottom of the slop did not exceed 4° to 5°F.

SUMMARY AND CONCLUSION

Freezing temperatures during the winter of 1957-58 resulted in severe damage in a rootstock test block near Weirsdale, Florida, and provided opportunity for evaluation of the effect of rootstock on the degree of injury to the Valencia orange tops. Forty-one rootstocks were rated according to the amount of killing of the Valencia tops and the results were analyzed statistically. A strong negative correlation between tree size and cold damage makes it necessary to take into account this relationship in evaluating the effect of rootstock on cold resistance of the scion variety.

In general, rootstocks which are themselves cold-resistant impart cold resistance to the scion variety. However, the numerous exceptions to this generalization suggest that some cold-susceptible stocks may also impart cold resistance and, conversely, some cold-resistant stocks may result in cold susceptibility of the scion. It is probable that the effect of the rootstock on cold resistance is an expression of the degree of dormancy produced in the scion.

The amount of protection against cold damage conferred by use of a cold-resistant stock, as compared with a cold-susceptible stock such as Rough lemon, may represent only a few degrees of temperature. In many instances this relatively small differential, however, can be of very real practical advantage.

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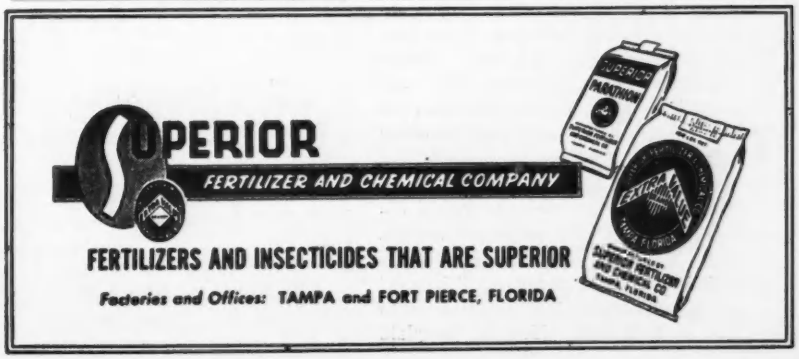
FLORIDA STATION GETS TWO RESEARCH GRANTS

The University of Florida Agricultural Experiment Station has been awarded two research grants totaling nearly 123 thousand dollars by the National Institutes of Health, according to Dr. Wm. R. Pritchard, head of the department of veterinary science.

Both grants are to be available over a three-year period. Dr. Pritchard says they will help support vitally needed research on fundamental aspects of two important animal diseases.

One — for $68,959 — goes to Dr. Pritchard and Dr. C. F. Simpson to study the cause of dissecting aneurysms in poultry. The other — for $53,784 — awarded to Dr. Pritchard and Dr. L. J. Corbo for a study of the viral diarrhea-mucosal disease complex in cattle.

The National Dairy Council says weight watchers will be interested to know that dairy foods — while they furnish so much in the way of needed nutrients — account for only one sixth of the food energy of our nation's diet. In other words, they're packed with nutrition per calorie.



UNFRUITFULNESS IN THE ORLANDO TANGELO

(Continued from Page 22)

ands of open pollinated flowers on 12 test trees at the Williams grove yielded only 62 fruits, while 200 cross-pollinations with Temple produced 120 fruits, and 200 comparable controlled self - pollinations yielded none. Taken alone, these data are strong evidence that all of the pollen varieties tested (Parson Brown, Pineapple, Valencia, Dancy, and Duncan) were highly effective in inducing fruiting in the Orlando. However, despite a considerable overlapping of the bloom period of all of the pollen varieties with Orlando, Table 3 shows that not all were effective as pollinizers under field conditions of open pollination. Similarly, Oppenheimer (4) has reported that the fruiting of Clementine was effectively increased by hand pollinating it with Valencia and Shamouti pollens, but that field observations indicated these varieties to be of little practical value as pollinizers.

Suitable Pollinizers. — Temple is the outstanding candidate as a pollinizer for Orlando; this is shown by data from Tables 2 and 3, and Fig. 1. Particularly noteworthy is the fact that the Orlando was found to be fruiting well in all 21 instances where it was growing adjacent to, or interplanted with Temple. In one instance, unfruitful Orlando trees produced a commercial crop of seedy fruit the first time that Temple (which had recently been topworked onto adjacent Hamlin trees) bloomed.

However, Temple should be used only as an interplant. It should not be topworked onto Orlando, because there is no known source of xyplorosis-free Temple wood, and if budded onto the non-tolerant Orlando, the tree will decline.

While a fewer number of field observations have been made on Dancy tangerines, all evidence is highly favorable. Excellent fruiting has occurred in several instances where Dancy has been used as a replant following the removal of xyloporosis infected Orlandos. One possible drawback is that Dancy characteristically blooms late and sometimes eratically. However, at this time it is the only variety which can be suggested for cold areas.

Valencia is a poor pollinizer. Table 2 shows that 50 Orlando fruits developed from 100 cross-pollinations with Valencia. In contrast, Table 3 indicates that under conditions of open pollination, the Valencia often had no noticeable effect on the yield of Orlando, and at best caused a moderate increase. Fig. 1 shows the small influence of Valencia as compared to Temple. Only 35 percent as many Orlando fruits were produced in the row bordering Valencia as in the one adjacent to Temple, and little or no effect due to Valencia was indicated past the first row. This may be due to the low percentage of Valencia pollen which is viable (Table 1), and the fact that relatively large amounts of pollen are transferred to the stigma in hand crosses as compared to the amounts transferred by bees.

Both Parson Brown and Pineapple have relatively high percentages of viable pollen. Nevertheless, Parson Brown has shown little influence on the fruiting of bordering Orlandos. In some cases, a very large influence apparently due to Pineapple has been noted while in others no influence whatsoever was found. There are possible explanations for this, but all are speculative and further work is needed to supply a factual answer.

Available experimental data indicate that Duncan grapefruit might be a suitable pollinizer; however, evidence concerning its effectiveness in the field is very limited.

No controlled experiments have been carried out with Hamlin orange or Marsh grapefruit, but field observations indicate they are probably unsuitable pollinizers for Orlando.

Self-incompatibility in Other Varieties.—The evidence presented that the Orlando is both self-incompatible and lacks a strong parthenocarpy is somewhat unusual, since the standard varieties of citrus in this country have been reported to be either highly parhenocarpic or self-fruited

Table 1.—Percentage germination of several varieties of citrus pollen from six locations in Polk and Lake counties, 1958.

Pollen variety	Location						Mean
	A	B	C	D	E	F	
Duncan	81	78	62	84	72	75	75
Marsh*	0	0	0	0	0	0	0
Hamlin	35	38	50	26	46	42	40
Parson Brown	52	25	37	45	51	36	41
Pineapple	39	46	52	31	38	55	44
Valencia	5	14	7	9	16	4	9
Dancy	83	60	58	75	72	55	67
Temple	75	70	81	76	82	61	74
Orlando	50	42	45	32	51	45	44

* An occasional germinating pollen grain was found.

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due to their ability to produce seeds when selfed (8,9). However, workers in Israel (4) and California (7) have reported the Clementine tangerine to be either unfruitful or partially fruited due to self-incompatibility and the lack of strong parthenocarpy. Similarly, Mustard et al (3) in Florida have recently reported that the Minneola tangelo, which has the same parentage as the Orlando, is unfruitful due to self-incompatibility, and the lack of strong parthenocarpy.

Table 2.—Influence of pollination and pollen variety on the fruiting of Orlando tangelos. 1958.

Pollen variety of treatment	No. flowers pollinated	*No. fruit 9/17/58	*% fruit 9/17/58	**No. seeds (range)
	Citrus Experiment Station			
Pineapple (caps)	50	43	86	16-36
Dancy (caps)	50	41	82	15-38
Orlando (caps)	100	0	0	——
No pollen (caps)	100	0	0	——
	Williams Grove			
Temple (caps)	100	58	58	29-35
Temple (no caps)	100	62	62	——
Orlando (caps)	100	0	0	——
Orlando (no caps)	100	0	0	——
Open pollinated	100	0	0	——
Total production from all open pollinated flowers on 12 test trees	—	62	—	——
	Hartle Grove			
Duncan (no caps)	150	105	70	26-32
Parson Brown (no caps)	100	51	51	18-36
Pineapple (no caps)	160	82	51	27-37
Valencia (no caps)	100	50	50	17-24
Dancy (no caps)	100	61	61	27-37
Temple (no caps)	140	92	64	24-32
Orlando (no caps)	750	2	0.2	0
	Totals			
Self-pollinated	1050	2	0.2	——
Cross-pollinated	1050	645	61	——

* Fruit on the tree at this date will normally remain until maturity.
** From all fruit at the Experiment Station; otherwise from samples of five fruit.

Distance from the Pollinizer. — Of significance to the grower, is the distance over which effective cressing takes place. Fig. 1 graphically portrays the influence of distance from the pollinating variety on the number of fruits per tree, and the number of seeds per fruit of young Orlando trees. Since it has been brought out previously that the Valencia is an unsuitable pollinizer, the small effects which are here shown as due to this variety of little significance. Quite pertinent is the rapid drop in the number of fruits per tree as the distance from Temple in increased. Even the second row from Temple had appreciably less fruit than the first; however, both had very good crops. The third and fourth rows had more fruit than rows farther distant, but the crops were erratic; i.e., some trees had good crops and some had very poor ones. More distant rows, while still showing some effects of cross-pollination, were fruiting very erratically and several trees had no fruit. The relationship between fruiting and seediness is not perfect, but both show that the distance over which highly tangelo is due to a combination of sexual self-incompatibility and the lack of strong, consistent parthenocarpy.

Data showing a striking increase in fruiting through the use of hand cross-pollinations are presented.

Gross observations in the field showed that some of the pollen varieties which very effectively induced fruiting when used in hand crosses were either partially or totally ineffective under field conditions of open pollination.

Where blocks of Orlando trees are unfruitful due to the failure to develop fruit when selfed, cross-pollination with the appropriate pollen variety is recommended as a means of increasing yields.

At this time, only Temple and Dancy can be recommended as pollen varieties. Further accumulation of data may show that other varieties are satisfactory.

Limited data suggests that for best results the Orlando should not be effective cross-pollination takes place is quite limited.

These data, while not conclusive, suggest that for best results the Orlando should not be separated from the pollinizer by more than two trees. This corresponds to the generally accepted recommendations for the planting of pollinizers in deciduous orchards (2).

Summary

Evidence is given that the unfruitfulness common to the Orlando separated from the pollinizer by more than two trees.

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Table 3.—The evaluation of crop size and seed content of Orlando tangelos bordering, interplanted with, and isolated from other varieties. 1958.

Pollen variety	No. of Locations	Size of crop* and seediness**					
		Satisfactory crop		Fair crop		Poor crop	
		Seedy	Seedless	Seedy	Seedless	Seedy	Seedless
		No. of occurrences					
Tangerines and hybrids							
Temple	21	21	0	0	0	0	0
Dancy	10	10	0	0	0	0	0
Orlando (selfed)	29	0	3	0	12	0	14
Oranges							
Valencia	16	0	0	7	0	0	9
Pineapple	10	5	0	2	0	0	3
Parson Brown	5	0	0	0	0	0	5
Hamlin	6	0	0	2	0	0	4
Grapefruit							
Duncan	1	1	0	0	0	0	0
Marsh	4	0	0	0	0	0	4
Ruby Red	4	0	0	0	2	0	2

* A poor crop is defined as a scattering of fruit; fair, upward to a half crop; satisfactory, upward to a full crop.
** If 80 percent or more of sampled fruit contained 5 or more seeds, it was seedy; if less, seedless.

J. R. Graves Makes Statement Outlining FCC Problems And Purposes

At the outset, please let me make it clear that the statement I am about to make is not mine alone, but has been carefully prepared from the combined thinking and judgment of this entire Commission. It has been prepared and is presented to you for the two-fold purpose of, first, informing and advising you of the plans and objectives of this Commission, and, second, not only to stimulate the thinking but also to seek the advice and counsel of industry leaders in planning our future courses of action. Please understand that these remarks concern our entire industry and are not directed at any particular part of it.

For the sake of clarity, this statement has been prepared under four headings:

A close and realistic look at the present position of our industry.

What this Commission thinks are some of the immediate problems facing the industry.

A resume of present plans for the Commission towards solving these problems.

Suggestions to industry ah to how it can cooperate with and augment the Commission program.

First, let us take a close and realistic look at the present position of our industry. Now that we are several months away from the long hard winter of last season, we can see more clearly that the freezes caused fundamntal effects much more far-reaching than the crop shortages and price rises which were the immediate results.

The Florida orange crop was reduced 20% by the freeze, and this, coupled with the shortest Californa crop in 30 years, put the Florida citrus industry in a most favorable supply position as compared to the demand for its products. The entire marketing outlook was changed almost overnight. Not only was the steady increase in the production of citrus abruptly halted, but also the all-out marketing effort of seeking new markets at profitable prices was changed to a policy of restricted sales at high price levels.

The shortened supplies and high prices resulting therefrom created many new problems for the industry, which brings us to the second part of this statement — a review of what we think are some of the immediate problems facing us.

It is axiomatic that during a period of short supplies and high price levels there is a general tendency toward lower overall quality standards. Certainly this was true in all channels of our trade last season, including all fresh and processed products. The return to products of the highest consumer preference is surely one of our immediate problems.

A period of high prices not only results in a reduction in the volume of citrus sales, but, more important results in a reduction in the number of customers using citrus. To emphasize this, of the families purchasing orange concentrate in July 1957, 23%, or almost one-fourth of them,

SOME NEW FACTS YOU SHOULD KNOW ABOUT LOW-COST AMMONIUM NITRATE AND SUBSOIL pH

Not only is there strong research proof that ammonium nitrate is best for citrus production, but there is also important new research proof that the **source of nitrogen has no effect on sub-soil acidity.**

From Preliminary Report on the Effect of Nitrogen Source and Rate and Lime Level on pH, Root Growth, and Soil Constituents in a Marsh Grapefruit Grove. By Paul F. Smith and Walter Ruether. U.S.D.A. Horticultural Field Station, Orlando, Florida.

(This is a continuing test using Calcium Nitrate, Ammonium Nitrate and Ammonium Sulphate. Two levels of lime were maintained.)

(Occasional editing and bold-face characters are ours. Complete report furnished on request.)

"If yield, tree growth, and fruit quality remain relatively unaffected, as they have during the first three years of this test, **the source of nitrogen cannot be considered as a primary factor** in citrus production on Florida acid soils.

"There is . . . **no evidence here to support** the postulation . . . that a substantial part of subsoil acidity in light Florida soils is attributable to the leaching of ammonia to the subsoil where nitrification stops but where direct ammonia absorbtion produces acidity."

Yes, proper liming. **No evidence to support the older theory** that subsoil acidity can be caused by nitrogen sources.

Add to this the important results[1] of a recent ten-year test: **"Mixtures of nitrate and ammoniacal nitrogen would appear preferable** as a maintenance nitrogen source where groves are in good physical condition and where sufficient dolomite is used to maintain the pH between 5.5 and 6.0 at all times."

Lime Is Always Necessary

Lime is necessary all the time, **whether you use ammonium nitrate or not.** pH alone is not enough. Calcium must be present in your citrus soil, according to Bryan and Nesmith[2]. They say,

"Repeated records are re-emphasizing **the need for ample soil calcium** as well as proper pH to maintain the highest fertilizer efficiency."

Use these important facts to cut your fertilizer costs and produce better quality fruit this year—the low-cost Dixie Nitrogen way.

For complete copies of the three reports quoted above, see your County Agent or write us.

Double Barreled, Low-Cost, 33.5% Dixie Nitrogen Contains the Ideal Balance of ½ Nitrate and ½ Ammoniacal Nitrogen.

Specify safe, dependable, low-cost DIXIE Nitrogen for your grove fertilizers.

Bold face and italicized characters are ours, as is editing.

1. Nitrogen Sources as Related to Yield and Quality of Hamlin Oranges" (A Ten-Year Summary) by John W. Sites, I. W. Wander and E. J. Deszyk, Florida Citrus Experiment Station, Lake Alfred.

2. Fertilizer and Soil Amendment Studies with Pineapple Oranges on Lakeland Sand. By O. C. Bryan and James Nesmith. A Progress Report of Short Research Grove 1949-1955. Published by Soil Science Foundation, Lakeland, Florida.

SOUTHERN DIXIE NITROGEN

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purchased no orange concentrate in July 1958.

Concentrate Over Half

Since over half our orange crop is marketed in frozen concentrate form, then the whole industry must be concerned with what is happening to this product. Another most important factor and one that should be clearly understood by all is the fact that the American consumer spends a fixed portion of his income, after savings, year in and year out, for food products. Food economists can tell us today almost the exact amount that will be spent for food in the United States during the next twelve months. The amount spent for food varies according to population trends and fluctuation in the index prices of foods.

Since it is a known fact that no amount of advertising and sale efforts will increase the over-all consumption of foods, then it becomes paramount that all of our consumer advertising and sales promotions should be channelled towards making the daily use of citrus a must in the diet of every person in this country. It is important to note here that the 23% of customers who purchased no orange concentrate in July 1958 did not reduce the amount that they spent for food. They spent their money for other food products in direct competition to citrus.

Competition

This brings us to a third important problem — new and vigorous competition from ads, blends, powders, etc., all of which are competing for their share of the consumers' dollar. I am sure that most of you are familiar with "TANG" - a new product developed by General Foods - which will be introduced to the American consumer this year in direct competition to citrus, with a reported $7,000,000.00 advertising and merchandising program on this product alone.

All of the aforementioned problems add up to one significant thing, which is marketing troubles and big troubles in future years unless careful planning towards right decisions are made now.

Just what are the long range plans of the Commission for the future? In facing up to our problems, it must be realized that the supply of citrus available for sale cannot be varied to meet changing conditions of demand as in manufactured products. If too many automobiles are produced in one period, production can be cut back during the next period in order to bring supply and demand more in balance.

Markets Must Expand

However, citrus trees set today commit us to a course of marketing problems five to ten years hence. Barring future catastrophes of nature' we are pretty well assured that we are only two or three years away from a 100,000,000 box crop of oranges, which simply means that our present markets must be expanded if we are to market such a crop at profitable prices. It is urgent then that we plan now to increase the future consumption of citrus, which can be done in the following three ways:

Expansion of our export markets.

Education of the increasing population of our nation to the use of citrus. This is estimated to provide a new market for 2,000,000 boxes a year.

Broadening the total market for citrus.

I feel that our biggest challenge is in broadening the total market for citrus. We need to give a lot of hard thinking to the job of selling, which involves advertising, merchandising, pricing and distribution. Every shipper and processor in the industry has a job to do here, and the Commission is no less responsible through our own advertising and merchandising programs.

The Commission's programs are particularly valuable because they induce in the consumer a buying habit, growing out of his deep-seated knowledge of the daily need for the health values contained in citrus fruits and juices. This produces a cumulative effect which underlies the sales effort of very shipper and processor. Without it, there could be no fundamental consumer understanding of what citrus will do for his health and satisfaction.

And thanks to 23 consecutive years of this kind of advertising, Florida citrus is close to the status of a staple in the American diet. We plan to continue to make searching appraisals of our advertising and merchandising programs so that they are geared for some steep climbs in production ahead.

All of our outlets of distribution must be invigorated with a fresh new effort to grow. Fresh fruit sales, canned juices, chilled juices, concentrates, and all other forms of citrus products must push forward in a maximum effort of hard-hitting, smart selling.

Research

We must accelerate and augment our research programs. We must continue to search for new cultural practices with partciular emphasis on those practices affecting internal and external qualities. Increased efforts will be made towards developing

(Continued on Page 30)

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If you're healthy, you'll probably live longer because as it's said, "an ounce of prevention is worth a pound of cure." If you're nervous, tired, rundown or stiff from rheumatism and arthritis, you can find relief as thousands of others have. You'll find the best at The Majestic where you can go from your room to the bathhouse in robe and slippers. Here you will find specialists who know their business—experienced attendants and masseurs for the men and masseuses for the ladies—all licensed in accordance with the regulations under the Director of the Nat'l Park Service, U. S. Dep't of the Interior.
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Reports Of Our Field Men . . .

HIGHLANDS AND POLK COUNTIES

R. E. Lassiter, Jr.,
P. O. Box 1304
Winter Haven, Fla.

Growers in this area have been busy applying their fall fertilizer application, and now are readying the groves for the winter season. The young trees are being banked and the wood and fire pots are being placed throughout the groves.

We had a light rain in this area around the first of November and moisture conditions are fairly good in most places.

Growers should continue to be on the lookout for red and purple scale infestations in their groves. These insects are still presenting quite a problem in this area. Purple mites and Texas citrus mites are beginning to be a problem at this time and these mites are expected to be worse as time goes by.

NORTH CENTRAL FLORIDA

L. D. Geiger, Jr.,
Phone STATE 7-3952
Leesburg, Fla.

Mid-November in North Central Florida finds the citrus growers very busy spraying, fertilizing, and picking fruit. Many of the growers have completed the fall application of fertilizer. Purple mite and scale are giving most all of the growers trouble.

With the recent heavy rains, many growers had to hold off picking until the fruit would again pass the test. The cool nights we have been having, however, are really making the fruit color up very well.

The truck crops around the Sanford area are coming in and some of the growers are picking eggplant, peppers, beans, etc. The heavy rains in this area also somewhat delayed the harvest of these crops.

PINELLAS, WEST PASCO, CITRUS & HERNANDO COUNTIES

Russell Fatic
811 N. Fort Harrison Ave.
Clearwater, Fla.
Phone 3-2487

Since the weather has remained unusually warm for this time of the year, we are spreading our fertilizer a little later than normal.

Many of the growers are bothered by their fruit splitting. All contributing factors are not known, but probably one of the greatest factors was the dry summer followed by a fair quantity of rain. Growers who did a considerable amount of irrigating this summer are not experiencing as much splitting as the others, generally.

Fruit is beginning to move in pretty substantial amounts now. Where grapefruit are being spot picked for size, we hope the ones remaining on the trees will still do a lot of sizing up.

SOUTH HILLSBOROUGH, MANATEE AND SARASOTA COUNTIES

Eaves Allison
P. O. Box 365, Sarasota, Fla.
Phone Fulton 8-2611

Good prices at this time (Nov. 11, or what used to Armistice Day) have justified early expectations in the citrus outlook. Sizes are running somewhat smaller here this year, which cuts down on the overall number of boxes some.

Tomato prices are good and early picking is proceeding as rapidly as possible in the Palmetto-Ruskin area. Heavy to flooding rains in the past week to ten days have retarded the shipments to some extent, but with good cool weather in the offing this lost ground should be regained.

Young grove plantings have almost recovered the ground lost during the freeze. By the time the spring growth flush is out in full they will be back where they started from. Naturally that good Lyons fertilizer has played a big part in this.

HILLSBOROUGH PASCO AND SUMTER COUNTIES

C. W. Dean
Gibsonton, Fla.
Phone Tampa 40-2592

We are having some very good weather at this time. Most of the growers have satisfactory moisture conditions and most of them have their cover crops cut in so they can disc when needed, to keep the moisture condition up. However, there are some that haven't as yet cut their cover crop in the ground. We hope that these people won't be too late in doing so. If they wait too long, it may be that they might bring a growth to their trees and if we do have some early cold, as has been predicted, it may bite the tender growth that this late cutting might start.

Most of the citrus groves in Pasco and Hillsborough Counties are having to be sprayed at this time to rid the groves of Purple Mites and Texas Citrus Mites. Both these mites are harmful to the tree if there is a large infestation of them. However, there are some growers that won't spray for these mites, even though they are harmful. We cannot over-emphasize the need of spraying for these insects and mites when they show up.

Oranges and grapefruit have begun to move quite regularly now. The fruit will be very small as compared to past years. I believe the weather conditions of this year and the cold we had is the main cause of this.

SOUTH POLK, HIGHLANDS, HARDEE AND DeSOTO COUNTIES

C. R. Wingfield
Phone: Glandale 2-8181
Avon Park, Fla.

Early in November we experienced a few days and nights of rather cool weather for this time of the year but by the 18th our temperatures during the day reached 85 degrees. However, the West is now having cold weather but the wave appears to be breaking up. The cool weather we had did cause our fruit to color very rapidly. Fruit movements are increasing in moderate rates, and tangerines are being picked for Thanksgiving market.

November has been and December will be busy times for both citrus and vegetable growers. The citrus man is applying his fall fertilizer application and getting it worked into the soil. Spraying for mite and scale and banking young trees.

We have had some rains over the area but still find spots that are dry and others wet, but are in a fair condition for moisture at this writing.

Uncle Bill Says:

Feller dropped by to see us the other day who used to live in Tampa about 30 years ago, then moved up North somewhere, 'n a few months ago he decided to retire and take it easy from now on . . . and the very first thing he decided to do after retirin' was to move back to Florida.

He spent a good deal of time remarkin' about how much everything had changed since he used to live here. Said the towns was all so much bigger, 'n that wide open spaces which used to surround most of any town was practically non-existent . . . 'n then he started to tell how much bigger and better the citrus groves looked today than they used to . . . 'n finally he wound up his talkin' by sayin' it seemed to him that evolution, er progress, er whatever a feller wanted to call it, had really taken over in Florida.

Then we had a chance to git our oar in and we suggested that the business of raisin' citrus, too, had undergone a lot of changes. We opined that new and improved methods of producin' citrus was enablin' us growers to produce more and better fruit. Improved fertilization methods and materials, we said, has made our groves look a heap better and our fruit look and taste better than ever before, while the development of citrus concentrate and the adoption of methods for producin' valuable citrus by-products made this business a lot bigger deal than it was 30 years ago.

'Nother thing we told him was that while most citrus growers know a lot more about takin' care of their production problems than they used to, that the Citrus Experiment Station, as a result of study and research, was able to advise growers on any of their citrus problems better than ever before, and that field service men from Lyons and other fertilizer producers was able to give sound and profitable advice to their customers.

Citrus growin' ain't all a bed of roses, but us growers certainly can get the very best counsel today, with a heap less trouble than used to be the case.

J. R. GRAVES MAKES STATEMENT OF FCC PLANS AND PURPOSES

(Continued from Page 27)

profitable by-products, and especially in developing new products for human consumption. Renewed effort will be placed on developing new methods, and improving present ones, of processing and handling citrus from the grove to the ultimate consumer.

Better techinques for determining and checking maturities and grades and improved processing procedures surely must come in for their share of a stepped up research program. Our research program must be geared to the needs of industry. It is the responsibility of the industry to keep our research staff fully informed as to its needs.

Quality, of course, must be paramount from the grove to the consumer. It is perhaps the most precious attribute a food product can have. There is no doubt that one of the principle reasons buyers and consumers continued to purchase large quanities of our fruit and products after the freezes is that they assumed that our quality would be maintained, and it was under the prevailing conditions.

Every fresh fruit shipper, every canner, chilled juice packer and concentrator should pause a moment as soon as he gets to work every morning and ask himself: "What can I do today to improve the quality of my product? Am I doing anything now that is hurting it in any way?" The temptations of economic short-cuts are tremendous, and the pressures of competition are overwhelming, but the long-range benefits of known integrity of high quality are priceless and permanent.

If our industry is to continue prosperous in future years, then surely industry itself has its share of responsibilities and must intelligently face up to them. It is, of course, wishful thinking to have complete and unanimous agreement within our industry, but cooperation certainly is to be desired and expected. No part of our industry can survive long at the expense of another. This only results in unrealistic practices that are not economically sound and that tend to retard the over-all progress of the industry. These are times that call for sound and constructive action.

These are challenging times for Florida citrus. We may consider that we are in a period of grace before high production seasons return. While it appears that this season will be a prosperous one, it does not remove the underlying problems that we all know exists. Our course of action to attack these problems, during the next twelve months, may well be the measure of our ability to continue prosperous for the next decade. We came through the severe freeze sound and strong, and we are confident we will move on in an alert and intelligent way.

In order that the Commission's programs may be successful, we want and need the active and wholehearted cooperation of every person and group in the industry.

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